



# THE MYXOPHYCEAE OF MARYLAND

BY

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CURATOR OF CRYPTOGAMIC BOTANY



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The algal flora of the middle and southern Atlantic states is very inadequately represented in herbaria and in the literature. Taylor in his *Marine Algae of the Northeastern Coast of North America* (1937) has made this fact evident in respect to the marine flora. The freshwater algae are known to us chiefly through the accumulated herbarium of Francis Wolle, whose publications ceased as long ago as 1893. Scattered local floras have been listed, but they are sketchy and their areas are extremely restricted; few of the specimens (if extant) which support them have found their ways out of private hands. The flora of brackish water, the most conspicuous elements of which are as a rule the Myxophyceae, has been almost totally neglected, even though the areas of salt marshes and tidewater here are probably as extensive as anywhere else in North America.

I was therefore greatly pleased to receive the invitation to visit and collect with Mr. Philip W. Wolle in Somerset County, Maryland, on the eastern shore of Chesapeake Bay, in August, 1938. Salt marshes occur along almost the entire shore of this county and on the islands attached to it. Tidewater rivers extend far inland. During a week's time, Mr. Wolle and I gathered in collections from every habitat, fresh, brackish, and semi-marine, that we could discover. We owe much of the success of this joint collecting to Mr. Roger White, Mr. Leo A. Bailey, and Dr. Robert H. Johnson, who gave us transportation to interesting and out-of-the-way places in the region.

Later, I had the pleasure of visiting Dr. Lewis P. McCann at College Park and of collecting with him and Dr. G. B. Reynard in Prince Georges County. Before leaving the state, I went with Dr. Mark W. Woods, Dr. McCann, and Mr. D. S. Stoddard on a tour into Garrett County, where opportunity arose to visit localities examined for algae in 1878 by Captain John Donnell Smith.

The number of collections of algae from eastern Maryland has been further augmented by Mr. Wolle's recent collecting. Dr. Harold C. Bold and Dr. F. E. Allison have obligingly given me much of their own blue-green algal material from the state for study.

In the citation of specimens below, serial numbers in italics are used to indicate my own collections or those made conjointly with others mentioned above. All of such collections were taken during



the period August 21–30, 1938. This material is cited as in my own herbarium, but duplicate specimens have been distributed to the Field Museum of Natural History, Mr. P. W. Wolle, the Farlow Herbarium, the Herbarium of Mr. J. C. Strickland, the New York Botanical Garden, the Naturhistoriska Riksmuseet at Stockholm, and elsewhere. In general, other specimens are to be found in herbaria as indicated by the following abbreviations: D, my personal herbarium; F, Farlow Herbarium of Harvard University; FM, Field Museum of Natural History; G, Herbarium of Goucher College; N, New York Botanical Garden; P, Herbarium of the University of Pennsylvania; U, United States National Herbarium. It is to be understood that, unless otherwise stated, references to Gomont are all to his 'Monographie des Oscillariées' (1892–93) and those to Bornet & Flahault are all to their 'Révision des Nostocacées heterocystées' (1886–88).

### The Chroococcaceae

CHROOCOCCUS TURGIDUS (Kütz.) Näg., Gatt. einzell. Alg. 46 (1849). *Protococcus turgidus* Kütz., Tab. Phyc. 1: 5 (1845).—In brackish water, SOMERSET COUNTY: marsh pool at Chance, 2268 (D); marsh pool west of Ewell, Smiths Island, 2306 (D); marsh pool, Tylerton, Smiths Island, *P. W. Wolle* (FM, Wolle).

APHANOTHECE STAGNINA (Spreng.) A. Br. in Rabenh., Fl. Eur. Algar. 2: 66 (1865). *Coccochloris stagnina* Spreng., Fl. Halens. Mant. 1: 14 (1807).—One specimen, from fresh water, CALVERT COUNTY: pool, Cove Point, *H. C. Bold*, 1936 (FM).

GOMPHOSPHAERIA APONINA Kütz., Alg. exs. Dec. 16: 151 (1836).—In brackish water, SOMERSET COUNTY: marsh pool between Chance and Dames Quarter, *P. W. Wolle*, June 12, 1938 (D), 2260 (D).

JOHANNESBAPTISTIA PELLUCIDA (Dickie) Tayl. & Drouet, Bull. Torr. Bot. Club 65: 285 (1938).—For the lengthy synonymy of this species, see the above reference. The three collections listed here extend the known range of this brackish-water species far to the north of that described previously. CONNECTICUT: with *Hydrocoleum Holdenii*, Fresh Pond, Stratford, *I. Holden* 1035, Sept. 1894 (D, F). MARYLAND: SOMERSET COUNTY: marsh pool west of Ewell, Smiths Island, 2307 (D); with *Gomphosphaeria aponina*, marsh pool between Chance and Dames Quarter, *P. W. Wolle*, July 12, 1938 (D).

### The Stigonemataceae

STIGONEMA MINUTUM (Ag.) Hass. ex Born. & Flah.—Two specimens from wet rocks: BALTIMORE COUNTY: Loch Raven, *J. E.*

*Humphrey*, Nov. 10, 1894 (G). GARRETT COUNTY: Deep Creek, *J. D. Smith*, July 26, 1878 (U).

STIGONEMA INFORME Kütz. ex Born. & Flah.—Also from wet rocks, GARRETT COUNTY: Falls of Deep Creek, *J. D. Smith*, July 26, 1878 (P, U).

STIGONEMA MAMILLOSUM (Lyngb.) Ag. ex Born. & Flah. f. **robustum** (Gardn.), *comb. nov.* *S. robustum* Gardn., Univ. Calif. Publ. Bot. 14: 9, pl. 4 (1927).—The Maryland material cited here is similar in habit and structure to the TYPE of *S. robustum* from China in the Farlow Herbarium and to material placed under the same name from Brazil (see Amer. Journ. Bot. 25: 658. 1938) in the Riksmuseet at Stockholm and from Virginia in my own herbarium. Morphologically, all of this material is indistinguishable, except for size of filaments, from those specimens cited as typical *S. mamillosum* by Bornet & Flahault. I have not had the opportunity to see a sufficient number of specimens to decide whether or not the two forms can always be separated with ease on the basis of size differences alone. One collection, from rocks partially submersed in swift, shallow water, GARRETT COUNTY: Swallow Falls, 2342 (D, FM).

HAPALOSIPHON PUMILUS (Kütz.) Kirchn. ex Born. & Flah. *H. fontinalis* (Ag.) Born., Bull. Soc. Bot. France 36: 156 (1888). *H. brasiliensis* Borge, Ark. f. Bot. 15 (13): 94 (1919).—In fresh water and wet places. WORCESTER COUNTY: Old Mill Pond, Nassawongo Creek, Atkinson's District, *P. W. Wolle*, Nov. 19, 1938 (FM). GARRETT COUNTY: 3 miles north of Oakland, 2336 (D).

### The Nostocaceae

NOSTOC PISCINALE Ag. ex Born. & Flah.—In fresh water, BALTIMORE COUNTY: Loch Raven, *C. E. Waters*, July 29, 1897 (F).

NOSTOC MUSCORUM Ag. ex Born. & Flah.—A very common soil alga throughout the northeastern and north central states, often most abundantly developed in dried rain pools. SOMERSET COUNTY: Wolle Farm, 3 miles northwest of Princess Anne, 2296 (D). PRINCE GEORGES COUNTY: on bank of Paint Branch at Riggs Road west of Beltsville, 2321 (D). GARRETT COUNTY: springy places in pasture 3 miles north of Oakland, 2341 (D).

NOSTOC COMMUNE Vauch. ex Born. & Flah.—BALTIMORE COUNTY: on earth, Loch Raven, *J. E. Humphrey*, Apr. 29, 1897 (G), *C. E. Waters*, July 24, 1897 (Phyc. Bor.-Amer. 403a, D, FM); Towson, *Humphrey*, Nov. 10, 1889, 1894 (G).

ANABAENA SPHAERICA Born. & Flah.—SOMERSET COUNTY: in a brackish ditch between Wenona and Deal Island, 2265 (D).

ANABAENA VARIABILIS Kütz. ex Born. & Flah.—In fresh water, WICOMICO COUNTY: on wet sand, Sandy Hill Beach, Tyaskin, 2252 (D).

NODULARIA HARVEYANA Thur. ex Born. & Flah.—SOMERSET COUNTY: floating in a brackish pond, Rhodes Point, Smiths Island, 2302 (D).

CYLINDROSPERMUM MAJUS Kütz. ex Born. & Flah. *C. janthinum* Dickie ex Born. & Flah., sp. inquir.—On moist soil. BALTIMORE COUNTY: rocks, *J. D. Smith*, May 13, 1878 (P, U). MONTGOMERY COUNTY: banks near Glen Echo, *F. E. Allison* 37, 38, July 10, 1937 (D, F, N).

CYLINDROSPERMUM MUSCICOLA Kütz. ex Born. & Flah. *C. caeruleum* Dickie ex Born. & Flah., sp. inquir.—MONTGOMERY COUNTY: in shallow water, Dalecarlia Reservoir, Conduit Road near District of Columbia, *F. E. Allison* 42, July 10, 1937 (D).

CYLINDROSPERMUM LICHENIFORME (Bory) Kütz. ex Born. & Flah.—MONTGOMERY COUNTY: on soil near Dalecarlia Reservoir, *F. E. Allison* 40, 41, July 10, 1937 (D, N).

### The Rivulariaceae

CALOTHRIX PULVINATA (Mert.) Ag. ex Born. & Flah.—In marine and brackish waters. WICOMICO COUNTY: on pilings in Nanticoke River, Sandy Hill Beach, Tyaskin, 2253 (D). SOMERSET COUNTY: with *Fremyella grisea*, on piling of old wharf at Shelltown, *P. W. Wolle*, Nov. 21, 1938 (FM).

RIVULARIA NITIDA Ag. ex Born. & Flah.—In wet brackish places. SOMERSET COUNTY: on cedar stumps at head of Pocomoke Sound, below Shelltown, *P. W. Wolle*, Nov. 21, 1938 (FM).

GLOEOTRICHIA NATANS (Hedw.) Rabenh. ex Born. & Flah. *Rivularia natans* (Hedw.) Welw. ex Born. & Flah., pro synon. *Rivularia* (*Gloeotrichia*) *flagelliformis* Gardn.,<sup>1</sup> Mem. New York Bot. Gard. 7: 71 (1927).—In fresh water, CALVERT COUNTY: Pt. Patience, *H. C. Bold*, 1937 (FM).

### The Scytonemataceae

FREMYELLA GRISEA (Born. & Flah.) J. DeToni, Noter. Nomencl. Algol. VIII (1936). *Microchaete grisea* Thur. ex Born. & Flah.—In

<sup>1</sup> The TYPE of *R. flagelliformis* in the New York Botanical Garden and an isotype in the U. S. National Herbarium (PUERTO RICO: in a water reservoir near Río Piedras, *N. Wille* 126, Dec. 28, 1914) consist of typical plants of *Gloeotrichia natans* with principally young spores and very few almost mature ones.

brackish and marine waters. SOMERSET COUNTY: on piling of old wharf at Shelltown, *P. W. Wolle*, Nov. 21, 1938 (FM).

TOLYPOTHRIX TENUIS Kütz. ex Born. & Flah. *T. rupestris* Wolle, F. W. Alg. U. S. 1: 265 (1887); Geitler, Rabenh. Kryptogamen-Fl. 14: 733 (1932).—In fresh water, BALTIMORE: on grasses in pools in abandoned brickyard, *J. E. Humphrey*, Oct. 10, 1896 (Phyc. Bor.-Amer. 257, FM).

SCYTONEMA TOLYPOTRICHOIDES Kütz. ex Born. & Flah. *S. gracile* var. *tolypotrichoides* Witttr. ex Born. & Flah., sp. inquir.—In fresh water, GARRETT COUNTY: Falls of Deep Creek, *J. D. Smith*, July 26, 1878 (P).

SCYTONEMA HOFMANNII Ag. ex Born. & Flah.—Subaerial in moist places, BALTIMORE COUNTY: on wet moss, Loch Raven, *J. E. Humphrey*, Nov. 10, 1894 (G).

SCYTONEMA OCELLATUM Lyngb. ex Born. & Flah.—Usually found on rocks and soil wet occasionally by rains. PRINCE GEORGES COUNTY: bank of Paint Branch at Riggs Road west of Beltsville, 2322 (D).

SCYTONEMA GUYANENSE (Mont.) Born. & Flah. *S. guyanense* var. *minus* Gardn.,<sup>1</sup> Mem. New York Bot. Gard. 7: 79 (1927).—On rocks and trees, most abundant in the warmer regions of the Western Hemisphere. BALTIMORE COUNTY: on wet rocks near L. Roland, *J. E. Humphrey*, Apr. 20, 1895 (G).

### The Oscillatoriaceae

SCHIZOTHRIX PURPURASCENS (Kütz.) Gom. *Hydrocoleum rufescens* Gardn.,<sup>2</sup> Mem. New York Bot. Gard. 7: 57 (1927).—A common inhabitant of soil wet only by rains in the eastern United States. GARRETT COUNTY: in an old field 3 miles north of Oakland, 2338 (D).

SCHIZOTHRIX MUELLERI Näg. ex Gom. *Hydrocoleum Hieronymii* Richt.<sup>3</sup> in Hauck & Richt., Phyk. univ. 543 (1892).—On moist soil

<sup>1</sup> The TYPE of this variety in the New York Botanical Garden, PUERTO RICO: on rocks along the roadside, Arecibo to Utuado, *N. Wille* 1455, Mar. 4, 1915, said to have filaments more tenuous than those in the typical variety, appears to differ in no respect from material of *S. guyanense* cited by Bornet & Flahault.

<sup>2</sup> The TYPE of *Hydrocoleum rufescens* in the New York Botanical Garden, PUERTO RICO: on red soil at the Experiment Station, Mayaguez, *N. Wille* 972, Feb. 6-8, 1915, is excellent material of *Schizothrix purpurascens*.

<sup>3</sup> I can find nothing to distinguish the isotypic material of *Hydrocoleum Hieronymii* in the Farlow Herbarium, GERMANY: in Carlowitz bei Breslau, *G. Hieronymus*, Sept.-Okt. 1891 (Phyk. univ. 543), from specimens of *Schizothrix Muellieri* cited by Gomont. Geitler has made a similar suggestion in Rabenh. Kryptogamen-Fl. 14: 1157 (1932).

and rocks, GARRETT COUNTY: with *S. Friesii*, Falls of Deep Creek, J. D. Smith, July 26, 1878 (U).

HYDROCOLEUM HOLDENII Tild., Rhodora 3: 254 (1901); Drouet, idem 40: 229 (1938). *H. majus* Holden, idem 1: 197 (1899), not Mart.—These Maryland records extend the known distribution far to the south of southern New England, whence previously recognized material has come. As in the northern part of its range, *H. Holdenii* is here an inhabitant of brackish pools. WORCESTER COUNTY: in a salt marsh 1 mile south of Public Landing, Assateague Bay, P. W. Wolle, Nov. 19, 1938 (FM). SOMERSET COUNTY: marsh ditch at Tylerton, Smiths Island, P. W. Wolle, Aug. 12, 1938 (FM, Wolle).

MICROCOLEUS CHTHONOPLASTES (Fl. dan.) Thur. ex Gom.—Often the commonest and most conspicuous alga on shores and about brackish pools. SOMERSET COUNTY: on mud flat between Ewell and Rhodes Point, Smiths Island, 2303 (D); brackish ditch between Wenona and Deal Island, 2266 (D); wet sand along Upper Thoroughfare, Deal Island, 2263 (D); on wet soil at White Haven Ferry, Mt. Vernon, 2251 (D).

MICROCOLEUS TENERRIMUS Gom.—In marine and brackish waters, SOMERSET COUNTY: on pilings, Wenona, 2284 (D).

MICROCOLEUS VAGINATUS (Vauch.) Gom.—As abundantly represented as *Nostoc Muscorum* on open soil wet occasionally by rains in eastern North America. PRINCE GEORGES COUNTY: with *Scytonema ocellatum*, bank of Paint Branch at Riggs Road west of Beltsville, 2322 (D).

PLECTONEMA GOLENKINIANUM Gom., Bull. Soc. Bot. France 46: 35 (1899); Collins, Holden & Setchell, Phyc. Bor.-Amer. 13: 603 (1899). *Lyngbya* (*Leibleinia*) *subtilis* Holden<sup>1</sup> in Collins, Holden & Setchell, Phyc. Bor.-Amer. 24: 1163 (1904), not West. *Lyngbya Holdenii* Forti,<sup>1</sup> Syll. Myxophyc. 260 (1907).—In marine and brackish water. SOMERSET COUNTY: with *Fremyella grisea*, on piling of old wharf at Shelltown, P. W. Wolle, Nov. 21, 1938 (FM).

<sup>1</sup> The case of *Lyngbya subtilis* Holden is a somewhat peculiar one. The original description was published in company with specimens of a true *Lyngbya* (see below) from Massachusetts which are quite different in nature from the TYPE in the Farlow Herbarium from CONNECTICUT: Bridgeport, I. Holden, Jan. 10, 1891. The form represented in the type specimen is similar to that of the co-type of *Plectonema Golenkinianum* Gom. distributed in Phyc. Bor.-Amer. 603. The two collections, one from Maine and the other from Massachusetts, distributed in Phyc. Bor.-Amer. 1007 under the manuscript name *Lyngbya subtilis* Holden, consist of this same species of *Plectonema*. The name *L. Holdenii* was proposed by Forti to replace the name preoccupied by *L. subtilis* West, Journ. Roy. Microsc. Soc. 1892: 741 (1892). The true *Lyngbya* represented in Phyc. Bor.-Amer. 1163 has already been described by Collins as *Schizothrix Simmonsi*, in Phyc. Bor.-Amer. 707. The isotypic specimens accompanying the description of *S. Sim-*

SYMPLOCA MUSCORUM (Ag.) Gom. *Phormidium Corium* var. *capitatum* Gardn.,<sup>1</sup> Univ. Calif. Publ. Bot. 14: 4 (1927). *P. interruptum* var. *capitatum* Gardn.,<sup>1</sup> Mem. New York Bot. Gard. 7: 44 (1927).—Also a soil form, often developing in places which are moist for a considerable part of the year. SOMERSET COUNTY: in an artesian spring, Kings Creek, 2292 (D). HARFORD COUNTY: Spesutie Island, J. D. Smith, Oct. 1878 (P). PRINCE GEORGES COUNTY: swamp 1 mile west of Beltsville, 2315, 2318 (D); soil under pear trees, Beltsville, F. E. Allison 16, June 14, 1937 (D). GARRETT COUNTY: Falls of Deep Creek, J. D. Smith, Oct. 1878 (U); on soil in an old field 3 miles north of Oakland, 2339 (D).

LYNGBYA AESTUARIUM (Mert.) Liebm. ex Gom.—Submersed and subaerial in brackish and marine waters. WORCESTER COUNTY: in a salt marsh at Public Landing, Assateague Bay, P. W. Wolle, Nov. 19, 1938 (FM). SOMERSET COUNTY: on mud in street, Ewell, Smiths Island, 2300 (D); brackish ditch, Ewell, 2308 (D).

LYNGBYA CONFEROIDES Ag. ex Gom.—On rocks and wood in marine waters. WORCESTER COUNTY: pilings of old wharf at Public Landing, Assateague Bay, P. W. Wolle, Nov. 19, 1938 (FM). SOMERSET COUNTY: jetty, Upper Thoroughfare, Deal Island, 2264 (D); on rocks, Wenona, 2282 (D).

LYNGBYA SEMIPLANA (Ag.) Ag. f. ex Gom.—On rocks etc. in marine and brackish waters. CALVERT COUNTY: in Chesapeake Bay, H. C. Bold, July 5, 1937 (FM).

*monsiæ* have all the characteristics of a species of *Lyngbya* in the hormogonial state and closely related to *L. gracilis* (Menegh.) Rabenh. ex Gom. For disposal of these specimens, I propose the following:

LYNGBYA *Simmonsiae* (Collins), *comb. nov.* *Schizothrix Simmonsiae* Collins in Collins, Holden & Setchell, Phyc. Bor.-Amer. 15: 707 (1900). Fila epiphytica, recta aut flexuosa, aggregata, flexilia, rosea vel aeruginea; vaginis tenuibus usque paullo incrassatis, hyalinis, passim lamellosis, parce mucosis, chlorozincico iodurato laete caerulescentibus; trichomatibus pallide aerugineis usque roseis, ad genicula evidenter constrictis, saepe torulosis,  $3\mu$  ad  $5\mu$  crassis, haud attenuatis; articulis subquadratis usque diametro sextuplo brevioribus,  $0.5\mu$  ad  $3.5\mu$  longis; protoplasmate homogeneo, passim tenui-granuloso; cellula apicali rotundata, calyptra nulla (v. s.).—Epiphytic on larger algae in quiet marine waters of southern New England: MASSACHUSETTS: on Enteromorpha, Magnolia, W. G. Farlow, Sept. 1903 (co-type of *Lyngbya subtilis* Holden in Phyc. Bor.-Amer. 1163, D, F, FM, N); water sample from Vineyard Sound, L. C. Lillick, Summer 1938 (FM). RHODE ISLAND: on algae in high rock pool, Easton's Point, Newport, Mrs. W. C. Simmons, Dec. 1897 (TYPE in Herb. New York Bot. Gard.; isotypes in Phyc. Bor.-Amer. 707, D, F, FM, N).

<sup>1</sup> The specimens (among them the TYPE from CHINA: Kuliang near Foochow, Fukien Province, H. H. Chung A402) in the Farlow Herbarium which Gardner cited with the original description of *Phormidium Corium* var. *capitatum* are excellent and typical material of the inundated form of *Symploca Muscorum*. The TYPE of *Phormidium interruptum* var. *capitatum* (PUERTO RICO: side of road near Humacao, N. Wille 540, Jan. 20-24, 1915) in the New York Botanical Garden is to be interpreted in a similar fashion.

LYNGBYA LUTEA (Ag.) Gom. *Oscillatoria sordida* Dickie ex Forti, Syll. Myxophyc. 192 (1907).—On rocks etc. in salt and brackish water, also on wet soil on shores. DORCHESTER COUNTY: on banks of Nanticoke River opposite Sandy Hill Beach (Tyaskin), 2258 (D).

LYNGBYA OCHRACEA (Kutz.) Thur. ex Gom.—In shallow pools in springy ground. PRINCE GEORGES COUNTY: below dam of pond, Riggs Road at Paint Branch west of Beltsville, 2325 (D).

PHORMIDIUM Weissii, sp. nov. Stratum aerugineum aut nigrescens, mucosum vel membranaceum; trichomatibus rectis undulatisve, fragilibus, paralleliter in muco amorpho hyalino chlorozincico iodurato haud caerulescente dispositis, ad genicula evidenter constrictis,

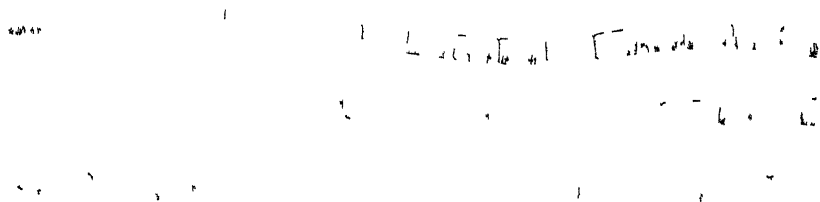


FIG. 1. *Phormidium Weissii*, sp. nov., drawn from the TYPE specimen by Mrs. Inez Austin.

numquam torulosis,  $1.0\mu$  ad  $2.5\mu$  crassis, superne rectis vel curvatis uncinatisve, ad apices sensim et longe attenuatis et acutis; articulis subquadratis aut diametro usque duplo longioribus,  $1.5\mu$  ad  $5\mu$  longis; protoplasmate per totam cellulam homogeneo, raro tenui-granuloso; dissepimentis conspicuis, haud granulatis; cellula apicali acute conica, haud capitata, sine calyptra (v. v., v. s., v. in form.). FIG. 1. In brackish and marine waters of low salinity along the eastern shore of North America, MASSACHUSETTS: in high pools on rocks, Black Rock, off Sconticut Point, Fairhaven, C. M. Palmer & Drouet 2177, Sept. 1, 1937 [TYPE in Herb. F. Drouet; Isotypes: British Museum (Natural History), F, FM, N, Naturhistoriska Riksmuseet (Stockholm), Herb. J. C. Strickland]; on rocks in high tide pools, Penikese Island, Gosnold, J. Cohn, July 10, 1934 (D); Botanical Survey of Penikese Island (Herb. Marine Biol. Lab.). MARYLAND: SOMERSET COUNTY: in a brackish pool, Wenona, 2279 (D); on *Ruppia* in a marsh pool between Ewell and Rhodes Point, Smiths Island, 2305 (D); road puddle at old wharf, Shelltown, P. W. Wolle, Nov. 21, 1938 (FM). FLORIDA: southwest Florida, J. D. Smith, Mar. 1878 (D, P, U). BAHAMA ISLANDS: in the lagoon, Watling Island, M. A. Howe 5095, Nov. 25, 1907 (D).

This well characterized species of brackish water has passed in herbaria and literature under several names: *P. Boryanum* in herb. Wolle; *P. tenue* according to Hazen in Lewis, *Rhodora* 26: 211 (1924); *P. valderianum* in Collins' list of algae in Britton & Millsbaugh, *The Bahama Flora*, p. 621 (1920); and *P. fragile* in my recent treatment of the southern Massachusetts Oscillatoriaceae in *Rhodora* 40: 260 (1938). In my own herbarium, material has heretofore been filed tentatively with *P. fragile* (Menegh.) Gom. and *P. subuliforme* Gom.; specimens of Nos. 2279 and 2305 from Maryland have been distributed to other herbaria under these names. Morphologically *P. Weissii* is closely related to these two species. It gives me much pleasure here to name this new form in honor of Mr. Philip Weiss Wolle, to whose ardent enthusiasm for microscopy and collecting I am chiefly indebted for the opportunity to study the Myxophyceae of the state of Maryland.

PHORMIDIUM INUNDATUM Kütz. ex. Gom. *P. purpurascens* var. *elegans* Drouet, Bot. Gaz. 95: 696 (1934).—One specimen from fresh water: BALTIMORE COUNTY: *J. D. Smith*, May 1878 (U).

PHORMIDIUM RETZII (Ag.) Gom. *P. leptodermum* var. *capitatum* Gardn.,<sup>1</sup> Mem. New York Bot. Gard. 7: 43 (1927).—In running fresh water. BALTIMORE COUNTY: on dripping rocks, Loch Raven, *J. E. Humphrey*, Apr. 4, 1895 (G). PRINCE GEORGES COUNTY: on stones in stream near Paint Branch at Riggs Road west of Beltsville, 2324 (D).

PHORMIDIUM FAVOSUM (Bory) Gom.—In running fresh water, etc. BALTIMORE COUNTY: near L. Roland, *J. E. Humphrey*, Mar. 23, 1895 (G); foul drain ditch, *J. D. Smith*, May 23, 1878 (P, U).

PHORMIDIUM SUBFUSCUM var. JOANNIANUM (Kütz.) Gom.—In running fresh water. BALTIMORE COUNTY: mill dam, *J. D. Smith*, May 1878 (P, U).

PHORMIDIUM UNCINATUM (Ag.) Gom.—In fresh water. BALTIMORE COUNTY: foul drain ditch, *J. D. Smith*, May 23, 1878 (P).

PHORMIDIUM AUTUMNALE (Ag.) Gom. *Lyngbya hahatonkensis* Drouet, Bot. Gaz. 95: 696 (1934).—On wet soil etc., seldom found submerged in fresh water. CALVERT COUNTY: watering trough, Solomons, *H. C. Bold*, July 2, 1936 (FM). CARROLL COUNTY: on soil in a farmyard at Sauble's Inn, Taneytown, *F. E. Allison* 30, July 5, 1937 (D).

<sup>1</sup>The TYPE of *P. leptodermum* var. *capitatum* in the New York Botanical Garden, PUERTO RICO: on rocks in a stream of warm water, Coamo Springs, *N. Wille* 364, Jan. 12, 1915, is excellent material of *P. Retzii*.



OSCILLATORIA PRINCEPS Vauch. ex Gom. *O. obtusa* Gardn.,<sup>1</sup> Mem. New York Bot. Gard. 7: 38 (1927). *Lyngbya gigantea* Lewis, Zirkle & Patrick, Journ. Elisha Mitchell Sci. Soc. 1933: 221 (1933).—In quiet fresh water, SOMERSET COUNTY: in seepage water, Kings Creek, 2290 (D); with *O. proboscidea*. 'Red Bridge,' headwaters of the Manokin River, Princess Anne, P. W. Wolle, July 6, 1938 (D).

OSCILLATORIA PROBOSCIDEA Gom. *O. refringens* Gardn.,<sup>2</sup> Mem. New York Bot. Gard. 7: 38 (1927).—In similar situations as, and often in company with, the preceding. SOMERSET COUNTY: 'Red Bridge,' headwaters of the Manokin River, Princess Anne, P. W. Wolle, July 6, 1938 (D). BALTIMORE: Biology Laboratory, Johns Hopkins University, J. E. Humphrey, Mar. 9, 1895 (G).

OSCILLATORIA LIMOSA Ag. ex Gom.—In fresh water. GARRETT COUNTY: J. D. Smith, Aug. 4, 1878 (U).

OSCILLATORIA CURVICEPS Ag. ex Gom.—In fresh water. BALTIMORE COUNTY: in stream, Loch Raven, J. E. Humphrey, Nov. 10, 1894 (G).

OSCILLATORIA ORNATA Kütz. ex Gom.—In fresh water. CALVERT COUNTY: with *Spirulina major*, Cove Point, H. C. Bold, July 6, 1937 (FM).

OSCILLATORIA MARGARITIFERA Kütz. ex Gom.—In brackish and semi-marine waters, SOMERSET COUNTY: marsh ditch at Wenona, P. W. Wolle, June 12, 1938 (D); marsh pool at Chance, 2269 (D); with *Hydrocoleum Holdenii*, marsh ditch at Tylerton, Smiths Island, P. W. Wolle, Aug. 12, 1938 (FM, Wolle).

OSCILLATORIA NIGRO-VIRIDIS Thw. ex Gom.—In marine and semi-marine waters. SOMERSET COUNTY: on pilings, Wenona, 2283 (D).

OSCILLATORIA TENUIS Ag. ex Gom. *O. tenuis* var. *levis* Gardn.,<sup>3</sup> Mem. New York Bot. Gard. 7: 38 (1927).—In quiet fresh water. SOMERSET COUNTY: Manokin River marsh, 2 miles west of Princess Anne, P. W. Wolle, Oct. 9, 1938 (FM). BALTIMORE COUNTY: foul drain ditch, J. D. Smith, Mar. 23, 1878 (P, U). ANNE ARUNDEL

<sup>1</sup> The TYPE of *O. obtusa* in the New York Botanical Garden, PUERTO RICO: in a pool, Parque Borinquen, Santurce, N. Wille 807, Feb. 3, 1915, is indistinguishable to me from other specimens which I have placed in *O. princeps*.

<sup>2</sup> The TYPE of *O. refringens*, PUERTO RICO: among water plants in the Turabo River, Caguas, N. Wille 486b, Jan. 15-17, 1915, in the New York Botanical Garden is typical material of *O. proboscidea*.

<sup>3</sup> The TYPE of *O. tenuis* var. *levis* in the New York Botanical Garden, PUERTO RICO: among other algae in the Turabo River, Caguas, N. Wille 486a, Jan. 17, 1915, appears to represent the larger form of *O. tenuis* designated as var. *natans* (Kütz.) Gom.

COUNTY: *Smith*, May 18, 1878 (P). GARRETT COUNTY: *Smith*, July 1878 (U).

OSCILLATORIA AMPHIBIA Ag. ex Gom.—In brackish and almost fresh water. SOMERSET COUNTY: marsh pool between Chance and Dames Quarter, 2161A (D).

OSCILLATORIA SALINARUM Collins in Collins, Holden & Setchell, Phyc. Bor.-Amer. 24: 1160 (1904). *O. luteola* Drouet, Rhodora 39: 277, f. 1 (1937).—When I described *O. luteola* in 1937, it had puzzled me that I had not found an earlier name for this very often encountered species of brackish water from the coasts of both Americas. The possibility of applying the name *O. salinarum* Collins had suggested itself, but at that time I had access only to the badly preserved and uninformative isotypic specimens distributed to several eastern herbaria in Phyc. Bor.-Amer. 1160. Recently I examined with great care the copious material of the TYPE in the New York Botanical Garden. Most of it is quite as dubious as that in the Phycotheca specimens, but certain portions are sufficiently well preserved to show that the species designated by Collins is the same as *O. luteola*. Collins' description is so sketchy that it might easily apply to several of Gomont's species. For a fuller characterization of *O. salinarum*, the reader is referred to the original description of *O. luteola*. SOMERSET COUNTY: brackish ditch, Ewell, Smiths Island, 2309 (D); with *O. margaritifera*, marsh ditch near Wenona, P. W. Wolle, June 12, 1938 (D); with *Hydrocoleum Holdenii*, Tylerton, Wolle, Aug. 12, 1938 (Fi, Wolle).

OSCILLATORIA FORMOSA Bory ex Gom.—In fresh water. SOMERSET COUNTY: roadside puddle, Church Street, Princess Anne, P. W. Wolle, Aug. 25, 1938 (FM, Wolle).

OSCILLATORIA BREVIS Kütz. ex Gom.—On moist soil and in rain-water pools. SOMERSET COUNTY: on mud, Wenona, 2277 (D).

OSCILLATORIA BREVIS var. NEAPOLITANA (Kütz.) Gom.—In brackish and semi-marine waters. SOMERSET COUNTY: on pilings, Wenona, 2287 (D); with *Phormidium Weissii*, puddle at old wharf, Shelltown, P. W. Wolle, Nov. 21, 1938 (FM).

SPIRULINA MAJOR Kütz. ex Gom. *S. densa* Lillick, Amer. Midl. Nat. 16: 210 (1935).—SOMERSET COUNTY: brackish pool, Wenona, 2288 (D). CALVERT COUNTY: Cove Point, H. C. Bold, July 6, 1937 (FM).

SPIRULINA TENERRIMA Kütz. ex Gom. *S. socialis* Gardn.,<sup>1</sup> New York Acad. Sci., Sci. Surv. Porto Rico 8: 272 (1932).—In brackish

<sup>1</sup> There appears to be no reason to separate the TYPE of *S. socialis* in the New York Botanical Garden, PUERTO RICO: Santurce, M. A. Howe 2162a, May 27, 1903, from other specimens of *S. tenerrima*.

and marine waters. SOMERSET COUNTY: marsh pool between Ewell and Rhodes Point, Smiths Island, 2304 (D).

SPIRULINA SUBSALSA Oerst. ex Gom. *Arthrospira subsalsa* Crow apud Croasdale, F. W. Alg. Woods Hole, Mass. 18 (1935).—In marine and brackish waters. SOMERSET COUNTY: with *Oscillatoria amphibia*, in a marsh pool between Chance and Dames Quarter, 2161A (D).

#### To Be Excluded

*Microcystis Donnellii* Wolle, Bull. Torr. Bot. Club 6: 282 (1879), is represented in the original collection by a ciliate protozoan with endophytic green cells: GARRETT COUNTY: *J. D. Smith*, July 1878 (TYPE in Herb. Univ. Pennsylvania; Isotype, U).





# FRANCIS WOLLE'S FILAMENTOUS MYXOPHYCEAE

BY

FRANCIS DROUET

CURATOR OF CRYPTOGAMIC BOTANY



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# FRANCIS WOLLE'S FILAMENTOUS MYXOPHYCEAE<sup>1</sup>

FRANCIS DROUET

In 1936, Professor Wm. Randolph Taylor suggested that I examine, among other historical collections of filamentous Myxophyceae, the specimens of Francis Wolle on file in the Herbarium of the University of Pennsylvania. The study was gradually extended to include material bearing Wolle's annotations in other North American and European herbaria. The observations now presented are designed to interpret in modern nomenclature many novelties and reports of species which Wolle published in this group of algae.

Francis Wolle<sup>2</sup> (1817–1893) was a minister and educator of the Moravian Church in Bethlehem and Nazareth, Pennsylvania. He became interested in natural history at an early age; his first serious work among cryptogams was on local bryophytes, in company with his friend, Eugene A. Rau of Bethlehem. When Wood's *Contribution to the Fresh-water Algae of the United States* appeared in 1872, he turned his attention to these algae and especially to the desmids. He made large collections in Pennsylvania, New York, and New Jersey and reported his findings in a series of short papers in the *Bulletin of the Torrey Botanical Club* and the *American Monthly Microscopical Journal* during the years 1875–1885. He entered into correspondence with many contemporary phycologists, including F. Hauck, Anton Hansgirg, Otto Nordstedt, and W. G. Farlow. H. W. Ravenel, J. Donnell Smith, Romyn Hitchcock, F. W. Anderson, and various less active collectors sent all of their freshwater algae to him for determination. He issued hundreds of duplicate specimens in exchanges with these and other workers and thus built up a considerable working herbarium of both European and American algae. His studies in the desmids led him to publish in 1884 a volume entitled *Desmids of the United States*; this he revised and enlarged in 1892. In 1887 he published a two-volume work on the freshwater Myxophyceae, Rhodophyceae, and Chlorophyceae, *Fresh-water Algae of the United States*. With I. C. Martindale he furnished lists

<sup>1</sup> Contribution from the Osborn Botanical Laboratory of Yale University, the Department of Botany of the Marine Biological Laboratory, and Field Museum of Natural History.

<sup>2</sup> For biographical data, see Appleton's *Encyclopaedia of American Biography* 6: 590 (1889); *The Moravian* (Bethlehem) 38: 97, 103 (1893); *Bot. Gaz.* 18: 109–110 (1893); and *Proc. Amer. Microsc. Soc.* 15: 245–246 (with photograph) (1894).



of algae for Britton's two catalogues of New Jersey plants (see below). The publications mentioned above were based almost entirely upon material which he had examined himself and which is preserved for us today in his own and his correspondents' herbaria. His one purely bibliographic work, *Diatomaceae of North America*,<sup>1</sup> appeared in 1891.

As the most voluminous writer on North American algae during the 1870's and 1880's, Francis Wolle excited considerable interest in the freshwater algal flora of the United States. Although he was not a botanist by profession, his accumulated herbarium and his wide acquaintance among phycologists afforded him excellent advantage for careful and meticulous work. His taxonomic concepts, as indicated by annotations upon specimens of Myxophyceae, are on the whole similar to those in use today; this fact is unfortunately obscured in his publications by an often unconventional style of writing and by the use of a contemporary nomenclature which is scarcely intelligible to us unless we consult his specimens.

Wolle's studies of Myxophyceae were in major part already completed before Thuret, Bornet, Flahault, and Gomont published their monumental treatises upon which our present understanding of the morphology and nomenclature among the filamentous forms is based. He worked in an age when the most usable manuals of algae were those of Kützing and Rabenhorst, in which were listed hundreds of

<sup>1</sup> Francis Wolle accumulated a very small number of diatoms in his herbarium and consulted but few actual specimens during the preparation of this book. It is evident that he had no particular interest in the group and that he wrote the volume for the sole purpose of completing his series of manuals of North American freshwater algae, not as a report of original research. He writes in the preface: "In the present volume is collected the cream of what has already been written on the subject, as well as the figures of all known American species together with the most approved system of classification." In a copy of Habirshaw's *Catalogue of the Diatomaceae* (1885) in Francis Wolle's library, Dr. H. H. Chase had underlined in red ink the species known to occur in North America. Wolle found illustrations in other publications for the species included in this list. Most of the pen-and-ink drawings of his original plates (now in the possession of Mr. Philip W. Wolle) are direct copies or outline tracings of figures in Schmidt's *Atlas der Diatomaceen-Kunde*, pls. 1-140 (1874-80). Other figures are obviously enlarged free-hand sketches of those of Van Heurck, *Synopsis des Diatomes de Belgique* (1885). The finished enlargements give the impression of having been made by someone not too sympathetic toward and appreciative of the details of diatom morphology, especially where shapes of cells and position, number, and size of markings are concerned. The figures thus copied from Van Heurck are at best inaccurate, and in some cases quite unlike the species which they were designed to represent. Some of Wolle's figures are original, drawn, according to Mr. Philip W. Wolle, from the published slides of H. L. Smith, *Diatomacearum Species Typicae* (1874 ff.). The preface to his book states that Francis Wolle submitted the plates to Dr. H. L. Smith for approval before they were photolithographed. Letters which passed between the two men on this subject appear to be lacking in the files of Rev. Wolle's correspondence.—RUTH PATRICK, ACADEMY OF NATURAL SCIENCES, PHILADELPHIA.

species and many genera distinguished from each other by means of characters either highly imaginative or of little importance in the classification now in vogue. Such chaotic taxonomy had a natural sequel in the popularity of theories of polymorphism among the algae, like those elaborated in Hansgirg's 'Ueber den Polymorphismus der Algen', Bot. Centralbl., Bd. xxii (1885), and in the preface to Wolle's *Fresh-water Algae*. In general these theories presupposed that there is no limit to the series of diverse morphological forms which might be assumed by a single species in the course of its complete life history. They were truly revolutionary ideas, which claimed the enthusiasm of many respected European workers on algae; they provided a colorful and plausible *raison d'être* for the vast array of species and genera in the manuals of the time. Wolle employed the nomenclature of Kützing, Rabenhorst, and Kirchner in his publications because there was no other to use; with this fact in mind, the student today need not be astonished that Wolle considered many of the species listed in his *Fresh-water Algae* as equivocal entities.

If we wish to understand the uninformative descriptions and often ambiguous nomenclature in the filamentous Myxophyceae of Kützing's *Species Algarum* (1849) or of Rabenhorst's *Flora Europaea Algarum* (1864-68), we find it wise to examine for ourselves the specimens upon which these authors based their descriptions or to consult the works of the few authors who have done so. Bornet & Flahault, in their *Révision des Nostocacées Hétérocystées* (1886-88), and Gomont, in his *Monographie des Oscillariées* (1892-93), in establishing the modern system of classification and nomenclature in the group, have interpreted most of these specimens in careful scientific language in accord with present ideas of morphology and life histories. Unfortunately, but few of Wolle's specimens fell into the hands of these authors. Setchell in *Erythea* 4: 189-194 (1896) and *ibid.* 7: 45-55 (1899) explained a number of additional specimens which had been cited in Wolle's publications. Otherwise, Wolle's Myxophyceae have remained unexamined and uninterpreted for half a century; as a consequence, reference to his publications in recent literature has been largely a source of confusion. A general disinterest in herbarium study of microscopic algae since 1900 and an increasing popularity of bibliographic research among phycophiles have brought about this state of affairs, much to the detriment of Francis Wolle's scientific reputation. In Forti's *Sylloge Myxophycearum* (1907) we find Wolle's now unintelligible descriptions copied

verbatim, often with errors of translation, transcription, or typography. Forti's Latin interpretations have again been translated into English, German, and other languages in recent manuals devoted to Myxophyceae. Students using these manuals find themselves confronted with a hodge-podge of species, the descriptions and figures of many quite uninformative. With the specimens of Wolle and other early authors carefully preserved and easily accessible in herbaria, there would seem to be little reason why such confusion should have existed for so long a period of time.

For a number of years after his death, Francis Wolle's herbarium and other possessions remained in the hands of his family in Bethlehem. In December, 1906, some two-thirds of the collection, numbering several thousand specimens, was presented to the University of Pennsylvania, where it has remained in the Herbarium ever since. The rest of the specimens, along with the scientific library, notebooks, and instruments, have been carefully preserved by his grandson, Mr. Philip Weiss Wolle of Princess Anne, Maryland. Very recently Mr. Wolle placed all the specimens still in his care on file in Field Museum of Natural History.

Specimens bearing Francis Wolle's annotations are to be found in considerable numbers in the herbaria of those botanists who received material in exchanges or who sent specimens to Wolle for determination. The Farlow Herbarium contains many such specimens received by W. G. Farlow. The United States National Herbarium contains the herbaria of J. Donnell Smith and Romyn Hitchcock. The New York Botanical Garden has much Wolle material from the personal collection of Eugene A. Rau. The Herbarium of Oberlin College contains the accumulated collection of F. D. Kelsey. Specimens studied by Prof. W. A. Setchell are on file in the Herbarium of the University of California. Specimens of H. W. Ravenel are to be seen in greatest abundance in the British Museum (Natural History) and in the Farlow Herbarium. Other material is in the Brooklyn Botanical Garden and the University of Michigan Herbarium. It is more than probable that specimens exist in other North American and European herbaria not consulted in this study.

The specimens of blue-green algae which passed through Wolle's hands are dried on paper or inclosed in envelopes. They are labeled with specific determinations in his handwriting, and commonly with notations of place, habitat, etc. In many instances the notes appear on the back of the mounting paper. Along with other data, letters or numerals are often to be noted; these refer to entries in his admir-

able series of illustrated notebooks or to pages and figures in publications consulted. Printed labels are attached to many specimens.

The scientific names used in Wolle's earlier papers are in general the same as those which appear on the labels of his specimens. Some of those of the *Fresh-water Algae*, however, cannot be correlated with specimens because changes in his nomenclature do not appear on the herbarium labels or in the notebooks, and because certain names employed in earlier papers are disregarded in the citation of synonymy in the book. Such names which have not been matched with specimens appear at the end of this paper in the list of *Inquirenda*. Many specimens bear incomplete labels; it is probable that this material is the basis for certain of the dubious reports included in this list. Future investigations may discover the missing data for some of the specimens, and the list may be further shortened by the finding of additional Wolle specimens in herbaria not here consulted. A few records of species cited in the *Fresh-water Algae* are admittedly dependent upon the specimens of H. C. Wood, the location of whose herbarium is unknown to us at this time.

For convenience and to avoid repetition of such records as appear in Tilden's *Myxophyceae of North America* (1910), I have omitted reference in the treatment below, except in certain special cases, to Forti's *Sylloge Myxophycearum*. Likewise, reference to Wolle's list of freshwater algae in Britton, *A Preliminary Catalogue of the Plants of New Jersey* (1881) is omitted because the same list of species in revised form is repeated in Britton, *Final Rep. State Geol. New Jersey*, vol. ii (1889). No reference is made to VanDersal & Cartledge, *Proc. Pennsylvania Acad. Sci.* 7: 1-7 (1933), in which Wolle's Pennsylvania records are copied.

I wish to express my gratitude for the co-operation of many persons during the course of this study: some have supplied invaluable information concerning Francis Wolle and his specimens; these and others have offered suggestions and performed numerous other courtesies. Among the many who have aided me I wish to thank especially Mr. Philip W. Wolle, Prof. Wm. Randolph Taylor, Prof. Wm. A. Setchell, Prof. John M. Fogg, Jr., Dr. Ruth Patrick, Prof. Charles Hodge, Mrs. Hartley C. Wolle, Prof. Tracy E. Hazen, Dr. Wm. N. Schwarze, Dr. B. E. Dahlgren, Dr. Julian A. Steyermark, Mr. Donald Richards, Miss Sophia Prior, Prof. Frederick Grover, Dr. F. R. Fosberg, Miss Rosalie Weikert, Dr. D. H. Linder, Dr. Ray Dawson, Dr. Vivian Trombetta, Dr. H. K. Svenson, and Dr. Wm. R.

Maxon. This work, in large part, was made possible through the aid of the Theresa Seessel Research Fellowship at Yale University.

In the citation of specimens below, herbaria are indicated by means of the following abbreviations: B, Brooklyn Botanic Garden; BM, British Museum (Natural History); C, Herbarium of the University of California; D, my personal herbarium; F, Farlow Herbarium of Harvard University; FM, Field Museum of Natural History; G, Herbarium of Goucher College, Baltimore; Mi, Herbarium of the University of Michigan; N, New York Botanical Garden; O, Herbarium of Oberlin College; P, Herbarium of the University of Pennsylvania; Pa, Academy of Natural Sciences, Philadelphia; PW, the collection of Philip W. Wolle in Field Museum of Natural History; T, Herbarium of Wm. Randolph Taylor; U, United States National Herbarium. Specimens cited without name of collector are to be understood as containing no such data or as bearing the name of Francis Wolle. For the sake of brevity I mention only the surnames of Dr. H. W. Ravenel, Capt. John Donnell Smith, Dr. C. F. Austin, and Dr. Romyn Hitchcock. Throughout the treatment the abbreviation 'F. W. Alg.' is employed in place of Wolle's *Fresh-water Algae of the United States* (1887).

### Stigonemataceae

STIGONEMA MAMILLOSUM (Lyngb.) Ag. ex Born. & Flah., Ann. Sci. Nat. VII Bot. 5: 77 (1887). *Stigonema multipartitum* Gardn., Univ. Calif. Publ. Bot. 14: 9 (1927). *S. robustum* Gardn., loc. cit. (1927). *S. contortum* Gardn., ibid. 11 (1927). *S. canadense* Wm. R. Taylor, Proc. Acad. Nat. Sci. Phila. 80: 94 (1928). *S. mamillosum* f. *robustum* Drouet, Field Mus. Nat. Hist. Bot. Ser. 20: 5 (1939).—Recent studies of considerable material of this species from Europe, both Americas, and Asia, including the original material upon which the above names are based, point to the conclusion that plants with slender filaments and those with broad filaments are but growth forms of a single variable species often in various stages of lichenization. Specimens seen: NEW JERSEY: stones, shore of lake (O); on rocks in stream, Sandfield, *Austin*, 1871 (P); Green Pond, 1880 (N); 'Siroisiphon lacustris' (P).

References: as *Siroisiphon coralloides* in Wolle, Bull. Torr. Club 6: 185 (1877), ibid. 8: 29 (1881), F. W. Alg. 270 (1887), Britton Final Rep. Geol. N. J. 2: 605 (1889); as *S. lacustris* in Wolle, Bull. Torr. Club 6: 185 (1877); as *S. pulvinatus* in Wolle, F. W. Alg. 268 (1887) in part; as *Stigonema informe* in Tilden, Minn. Alg. 1: 249 (1910) in part.

STIGONEMA INFORME Kütz. ex Born. & Flah., *ibid.* 5: 75 (1887).—Specimens seen: PENNSYLVANIA: 'Scytonema callitrichoides' (P); rocks, Onoko, July 1875 (D, P); wet rocks (N, U); July, Nov. 1875 (F). MARYLAND: Falls of Deep Creek, Garrett County, *Smith*, July 1878 (P, U).

References: as *Sirosiphon alpinus* in Wolle, *Bull. Torr. Club* 6: 185 (1877); as *S. pulvinatus* in Wolle, *F. W. Alg.* 268 (1887) in major part; as *S. pulvinatus* f. *alpinus* in Wolle, *ibid.* 269 (1887) in part; as *Stigonema informe* in Setchell, *Erythraea* 4: 191 (1896), in Tilden, *ibid.* 249 (1910), in part, in Drouet, *Field Mus. Nat. Hist. Bot. Ser.* 20: 5 (1939).

STIGONEMA MINUTUM (Ag.) Hass. ex Born. & Flah., *ibid.* 5: 72 (1887). *Sirosiphon lignicola* Wood ex Born. & Flah. *pro. synon.*, *ibid.* 5: 73 (1887); Wood, *Proc. Amer. Philos. Soc.* 11: 133 (1869). *S. acervatus* Wood ex Born. & Flah. *pro. synon.*, *loc. cit.* (1887); Wood, *ibid.* 132 (1869). *S. pulvinatus* f. *mamillosus* Wolle,<sup>1</sup> *F. W. Alg.* 270 (1887).—Specimens seen: PENNSYLVANIA: Onoko, 1875 (F, P); shaded rocks (C, D, P); 'Stigonema minutum var. saxicola' (Wittr. & Nordst., *Alg. exs.* 669, N, PW); 'Sirosiphon compactus' (P). MARYLAND: Deep Creek, Garrett County, *Smith*, July 1878 (U). WEST VIRGINIA: Blackwater, Tucker County, *Smith*, July 1878 (U); Blackwater Fork of Cheat River, *Smith*, July 1878 (U). SOUTH CAROLINA: on boards, Aiken, *Ravenel* 39 (ISOTYPE of *Sirosiphon lignicola*, C), 76 (F), 240 (P), 375 (F); Aiken, *Ravenel* 146 (F), 547, 549, 550, Dec. 1884 (PW); granite walls, Aiken, *Ravenel* 498, Nov. 1883 (F); in running water, Aiken, *Ravenel* 74, Apr. 1869 (C); Aiken, on bark of trees, *Ravenel* 107, (C), 109 (BM); on limbs of *Nyssa*, *Ravenel* 169 (C); on bark of *Ilex opaca*, *Ravenel* 44 (ISOTYPE of *Sirosiphon acervatus*, C); on *Ailanthus*, Aiken, *Ravenel* 300 (BM); on pine boards, St. Johns, Berkeley Parish, Charleston, *Ravenel* 339, Mar. 1880 (F).

References: as *Stigonema minutum* var. *saxicola* in Wolle, Wittr. & Nordst. *Alg. exs.* 13: 669 (1883); as *Sirosiphon pulvinatus* f. *alpinus* in Wolle, *F. W. Alg.* 269 (1887) in part; as *S. compactus* in Wolle, *ibid.* 271 (1887) in part; as *S. lignicola* in Wolle, *ibid.* 273 (1887) in part; as *Stigonema minutum* in Setchell, *Erythraea* 7: 47 (1899), in Tilden, *Minn. Alg.* 1: 248 (1910), in Drouet, *Field Mus. Nat. Hist. Bot. Ser.* 20: 4 (1939); as *S. tomentosum* in Tilden, *ibid.* 246 (1910).

STIGONEMA PANNIFORME (Ag.) Born. & Flah., *ibid.* 5: 71 (1887). *Sirosiphon argillaceus* Wood ex Born. & Flah. *pro. synon.*, *loc. cit.* (1887); Wood, *Smiths. Contrib. Knowl.* 241: 73 (1872).—Specimens

<sup>1</sup> I find no specimens labeled thus, but it appears certain that the West Virginia specimens labeled *S. alpinus* and cited here form the basis of the description and figure of *S. pulvinatus* f. *mamillosus*. Mixed with *Stigonema minutum* in this material are poorly developed filaments possibly referable to *S. informe* Born. & Flah.

seen: SOUTH CAROLINA: damp clay, Aiken, *Ravenel* 79 (ISOTYPE of *Sirosiphon argillaceus*, F), 216, 225 (F, P), 544 (PW).

References: as *S. compactus* in Wolle, F. W. Alg. 271 (1887) in part; as *S. argillaceus* in Wolle, *ibid.* 273 (1887); as *Stigonema panniforme* in Tilden, Minn. Alg. 1: 245 (1910) in part.

STIGONEMA OCELLATUM (Dillw.) Thur. ex Born. & Flah., *ibid.* 5: 69 (1887). *S. anomalum* Blanchard,<sup>1</sup> *Rhodora* 15: 194 (1913).—Specimens seen: NEW JERSEY: 'Sirosiphon ocellatus' (D, N); 'S. Crameri' (P); old path, Closter, Nov. 1877 (P); with *Hapalosiphon pumilus*, Bamber, Ocean County (P); in Bamber Lake, 1883 (Witt. & Nordst., Alg. exs. 668, PW, N).

References: as *Sirosiphon ocellatus* in Wolle, Bull. Torr. Club 6: 285 (1879), Witt. & Nordst. Alg. exs. 13: 668 (1883), F. W. Alg. 272 (1887), Britton Final Rep. Geol. N. J. 2: 605 (1889); as *S. Crameri* in Wolle, Bull. Torr. Club 6: 185 (1877), F. W. Alg. 272 (1887); as *Stigonema ocellatum* in Setchell, *Erythea* 7: 48 (1899), in Tilden, Minn. Alg. 1: 247 (1910).

STIGONEMA HORMOIDES (Kütz.) Born. & Flah., *ibid.* 5: 68 (1887). *Sommierella hormoides* Borzi, N. Giorn. Bot. Ital., N. S. 24: 79 (1917).—Specimens seen: PENNSYLVANIA: with *Stigonema informe*, wet rocks, 1878 (N, U); 'Scytonema callitrichoides' (D, P).

References: as *Sirosiphon compactus* in Wolle, F. W. Alg. 271 (1887) in part; as *Stigonema hormoides* in Setchell, *Erythea* 7: 47 (1899).

FISCHERELLA THERMALIS (Born. & Flah.) Gom., Journ. de Bot. 9: 52 (1895). *Stigonema thermale* (Schwabe) Borzi ex Born. & Flah., Ann. Sci. Nat. VII Bot. 5: 66 (1887).—Specimens seen: NEW JERSEY: rotten wood, Austin (P). FLORIDA: *Smith*, Mar. 1878 (P, U). TEXAS: on damp fallen logs, Houston, *Ravenel* 21 (P).

Reference: as *Hapalosiphon Braunii* in Wolle, F. W. Alg. 275 (1887) in part.

FISCHERELLA AMBIGUA (Born. & Flah.) Gom., loc. cit. (1895). *Scytonema ambiguum* Kütz. ex Born. & Flah., *ibid.* 5: 100 (1887). *S. badium* Wolle ex Born. & Flah. sp. inquir., *ibid.* 5: 111 (1887); Wolle, Bull. Torr. Club 6: 184 (1877). *Phormidium interruptum* var. *rigidum* Gardn., Mem. New York Bot. Gard. 7: 44 (1927).—The well preserved original material of *Scytonema badium* is similar to specimens of *Fischerella ambigua* treated by Gomont. Specimens seen: NEW YORK: Herkimer County, Austin, 1868 (TYPE of *Scytonema*

<sup>1</sup> Isotypic material of *S. anomalum* distributed in Phyc. Bor.-Amer. 1952, MASSACHUSETTS: Chebacco Pond, Essex, F. D. Lambert, Oct. 1909 (F, FM, N), appears to me to represent a growth form of *S. ocellatum* with well developed narrow branches and hyaline sheaths; in older parts of the same masses, the filaments are similar in every respect to those of other specimens of *S. ocellatum*.

*badium*, P). SOUTH CAROLINA: with *Schizothrix arenaria* on ground, Aiken, *Ravenel* 254 (F), 502 (PW).

References: as *Scytonema badium* in Forti, Syll. Myxophyc. 524 (1907), in Tilden, Minn. Alg. 1: 225 (1910), in Geitler, Rabenh. Krypt-Fl. 14: 786 (1932).

FISCHERELLA MAJOR Gom., Journ. de Bot. 16: 299 (1902).—The few specimens are similar to the material (presumably isotypic) distributed in Mus. Vindob. Krypt. Exs. 333 (N). They are: SOUTH CAROLINA: earth, Aiken, *Ravenel* 102 (BM), 143 (BM, F); granite walls, Aiken, *Ravenel* 498, Nov. 1883 (PW).

Reference: as *Symploca lucifuga* in Wolle, F. W. Alg. 303 (1887) in part.

HAPALOSIPHON PUMILUS (Kütz.) Kirchn. ex Born. & Flah., Ann. Sci. Nat. VII Bot. 5: 61 (1887). *H. fontinalis* (Ag.) Born., Bull. Soc. Bot. France 36: 156 (1889). *H. brasiliensis* Borge, Ark. f. Bot. 15 (13): 94 (1919).—Specimens seen: NEW JERSEY: Swartwood Lake, 1879 (D, P); Bamber, Ocean County (P); Hammerton Pond, Aug. 1879 (P; Wittr. & Nordst., Alg. exs. 390, N. PW, U); Absecon, July 1878 (D, P). PENNSYLVANIA: with *Porphrysiphon Notarisii* as 'Hydrocoleum heterotrichum' (P); 'Hapalosiphon Braunii' (U). SOUTH CAROLINA: in pools of water, Aiken, *Ravenel*, Feb. 1878 (P), 470, Nov. 1883 (PW).

References: as *H. Braunii* in Wolle, Bull. Torr. Club 6: 285 (1879), Wittr. & Nordst. Alg. exs. 8: 390 (1880), F. W. Alg. 275 (1887), Britton Final Rep. Geol. N. J. 2: 606 (1889), in part; as *H. fuscens* of Wolle, Bull. Torr. Club 6: 285 (1879), F. W. Alg. 277 (1885), Britton Final Rep. Geol. N. J. 2: 606 (1889); as *H. fontinalis* in Tilden, Minn. Alg. 1: 239 (1910).

### Nostocaceae

NOSTOC PISCINALE Kütz. ex Born. & Flah., Ann. Sci. Nat. VII Bot. 7: 194 (1888).—Specimens seen: PENNSYLVANIA: pool, Aug. 1876 (F); canal below Nisky (N); pool near Bethlehem (P, U); 'N. lacustre-comminutum' (D, P).

References: as *N. comminutum* in Wolle, F. W. Alg. 282 (1887) in part, in Tilden, Minn. Alg. 1: 165 (1910) in part.

NOSTOC RIVULARE Kütz. ex Born. & Flah., *ibid.* 7: 195 (1888).—Specimens seen: GEORGIA: still water, Darien, *Ravenel* 445, Nov. 1881 (F). FLORIDA: *Smith*, 1878 (P, U).

References: as *N. comminutum* in Wolle, loc. cit. (1887) in part, in Tilden, loc. cit. (1910) in part; as *Cylindrospermum flexuosum* in Wolle, *ibid.* 292 (1887) in part.

NOSTOC COMMUNE Vauch. ex Born. & Flah., *ibid.* 7: 203 (1888).—Specimens seen: NEW YORK: Portage, 1876 (P); on moss, Niagara, 1876 (P). NEW JERSEY: rocks, *Austin* (P); Closter, 1863 (P). PENN-



SYLVANIA: in consortis *Scytonem. Myochr.* (Wittr. & Nordst., Alg. exs. 890, N, PW); Rockdale, 1863 (P). FLORIDA: *Smith*, Mar. 1878 (U). MONTANA: *F. W. Anderson*, 1886 (PW). COLORADO: on water, on moist ground, *Brandegge*, 1877 (P); on *Grimmia*, *Austin*<sup>1</sup> (U); May 1877 (N).

References: as *N. Muscorum* in Wolle, Bull. Torr. Club 6: 283 (1879), *F. W. Alg.* 282 (1887), in Tilden, Minn. Alg. 1: 169 (1910); as *N. comminutum* in Wolle, loc. cit. (1887) in part; as *N. humifusum* in Wolle, loc. cit. (1887), in Tilden, *ibid.* 170 (1910); as *N. commune* in Wolle, *F. W. Alg.* 283 (1887), Britton Final Rep. Geol. N. J. 2: 606 (1889), Wittr. & Nordst. Alg. exs. 18: 890 (1890), in Tilden, *ibid.* 171 (1910); as *N. sphaericum* in Wolle, *F. W. Alg.* 283 (1887) in part, in Tilden, *ibid.* 173 (1910) in part; as *N. caeruleum* of Wolle, *ibid.* 284 (1887), in Tilden, *ibid.* 177 (1910).

NOSTOC COMMUNE var. FLAGELLIFORME (Berk. & Curt.) Born. & Flah., *ibid.* 7: 206 (1888).—The Texas collection is of the same material as that distributed by Farlow, Anderson & Eaton in Alg. Am. Bor. Exs. 100. Specimens seen: KANSAS: on red clay soil, Barbour County, *F. W. Cregin*, 1888 (D, P). TEXAS: *C. Wright* (FM, P).

References: as *N. flagelliforme* in Wolle, *F. W. Alg.* 285 (1887); as *N. commune* var. *flagelliforme* in Tilden, Minn. Alg. 1: 173 (1910).

NOSTOC MICROSCOPICUM Carm. ex Born. & Flah., Ann. Sci. Nat. VII Bot. 7: 210 (1888).—Specimens seen: PENNSYLVANIA: wet rocks (D, P); Pike County (D, P).

References: as *N. riparium* in Wolle, Bull. Torr. Club 6: 217 (1878) in part; as *N. sphaericum* in Wolle, *F. W. Alg.* 283 (1887) in part, in Tilden, Minn. Alg. 1: 173 (1910) in part.

NOSTOC CAERULEUM Lyngb. ex Born. & Flah., *ibid.* 7: 213 (1888).—One specimen: MINNESOTA: Lake of the Isles, Minneapolis, *E. Butler*, 1883 (PW).

NOSTOC PRUNIFORME (L.) Ag. ex Born. & Flah., *ibid.* 7: 215 (1888).—Specimens seen: NEW JERSEY: in rivulets, Closter, *Austin* (P), 1870 (P), 1877 (P); 'N. cristatum-riparium' (P). PENNSYLVANIA: 'N. pruniforme' (B, O, P, U); river stones (O, P); canal below Nisky (N); pool near Bethlehem, Aug. 1878 (P, U); in stagnis, Bethlehem, 1877 (Rabenh. Alg. 2530, N); meadow pools (D, O, P, U); rock pool, Nisky (N); near Brofuss Lock, Aug. 1877 (N).

References: as *N. cristatum* in Wolle, Bull. Torr. Club 6: 183 (1877); as *N. riparium* in Wolle, loc. cit. (1877) in part; as *N. pruniforme* in Wolle, loc. cit. (1877), Rabenh. Alg. 2530 (1878), *F. W. Alg.* 284 (1887), in Tilden, Minn. Alg. 1: 178 (1910); as *N. sphaericum* in Wolle, *ibid.* (1887) in part, in Tilden, *ibid.* 173 (1910) in part; as *N. alpinum* in Wolle, *ibid.* 285 in part (1887), Britton Final Rep. Geol. N. J. 2: 606 (1889); as *N. parmelioides* in Tilden, *ibid.* 181 (1910) in part.

<sup>1</sup> This label is in Capt. Smith's handwriting. The collection is more probably one by T. S. Brandegge than one by C. F. Austin.

NOSTOC VERRUCOSUM (L.) Vauch. ex Born. & Flah., *ibid.* 7: 216 (1888).—Specimens seen: PENNSYLVANIA: Skinner's Spring, July 1877 (D, N, O, P); 'N. alpinum' (F, P); Derry Church, Dauphin County, Oct. 1887 (PW).

References: as *N. verrucosum* in Wolle, F. W. Alg. 284 (1887), in Tilden, Minn. Alg. 1: 179 (1910); as *N. alpinum* in Wolle, *ibid.* 285 (1887) in part.

NOSTOC PARMELIOIDES Kütz. ex Born. & Flah., *ibid.* 219 (1888).—One specimen: PENNSYLVANIA: Monocasy's Spring, 1877 (N).

References: as *N. alpinum* in Wolle, F. W. Alg. 285 (1887) in part; as *N. parmelioides* in Tilden, Minn. Alg. 1: 181 (1910) in part.

NOSTOC sp.—One ill-preserved specimen: CALIFORNIA: on *Cladophora* (P).

References: as *N. glomeratum* in Wolle, Bull. Torr. Club 6: 183 (1877), in Tilden, Minn. Alg. 1: 177 (1910).

WOLLEA SACCATA (Wolle) Born. & Flah., *Ann. Sci. Nat. VII Bot.* 7: 223 (1888). *Sphaerozyga saccata* Wolle ex Born. & Flah. pro. synonym., loc. cit. (1888); Wolle, Bull. Torr. Club 7: 44 (1880).—The spores in the collections are by no means mature. Specimens seen: NEW JERSEY: cranberry pond, Waterloo, 1879 (ISOTYPE, P); pond (O); in aqua stagnante, July 1879 (ISOTYPE in Wittr. & Nordst., Alg. exs. 397, N, PW).

References: as *Sphaerozyga saccata* in Wolle, Wittr. & Nordst. Alg. exs. 8: 397 (1880), F. W. Alg. 290 (1887); as *Wollea saccata* in Wolle, Britton Final Rep. Geol. N. J. 2: 607 (1889), in Tilden, Minn. Alg. 1: 181 (1910).

ANABAENA CIRCINALIS (Kütz.) Rabenh. ex Born. & Flah., *Ann. Sci. Nat. VII Bot.* 7: 230 (1888). *Microcystis lobata* Dickie, *Journ. Linn. Soc. Bot.* 18: 128 (1880). *Anabaena scabra* Dickie ex Born. & Flah. sp. inquir., *ibid.* 7: 239 (1888).—One specimen: MINNESOTA: Minneapolis, *E. Butler*, Oct. 1882 (P).

References: as *A. circinalis* in Wolle, Bull. Torr. Club 10: 21 (1883), in Tilden, *ibid.* 190 (1910); as *A. flos-aquae* var. *circinalis* in Wolle, F. W. Alg. 287 (1887).

ANABAENA CATENULA (Kütz.) Born. & Flah., *ibid.* 7: 232 (1888).—One collection: MINNESOTA: Lake Stay, *E. Doolittle*, 1888 (PW).

ANABAENA OSCILLARIOIDES Bory ex Born. & Flah., *ibid.* 7: 233 (1888).—Specimens seen: PENNSYLVANIA: 'Cylindrospermum flexuosum' (D, P). GEORGIA: salt marsh mud flats, Darien, *Ravenel 311* (F). MONTANA: Helena, *F. D. Kelsey*, 1889 (PW); Oro Fino Gulch near Helena, *F. W. Anderson 43*, June 1887 (PW).

References: as *Cylindrospermum limicola* in Wolle, F. W. Alg. 292 (1887) in part; as *C. flexuosum* in Wolle, loc. cit. (1887) in part; as *Anabaena oscillarioides* in Tilden, Minn. Alg. 1: 193 (1910) in part.

ANABAENA spp.?—These specimens appear to represent species of *Anabaena* but are in a sporeless or otherwise unrecognizable state: PENNSYLVANIA: 'Limnochilde' (P). SOUTH CAROLINA: *Smith*, Mar. 1878 (P).

References: as *Aphanizomenon flos-aquae* in Wolle, F. W. Alg. 291 (1887), in Tilden, Minn. Alg. 1: 196 (1910); as *Cylindrospermum limicola* in Wolle, *ibid.* 292 (1887) in part.

CYLINDROSPERMUM MAJUS Kütz. ex Born. & Flah., Ann. Sci. Nat. VII Bot. 7: 252 (1888). *C. janthinum* Dickie ex Born. & Flah. sp. inquir., *ibid.* 7: 255 (1888).—The material labeled 'Phormidium congestum' by Wolle is a mixture of *C. majus* and several terrestrial species of *Schizothrix* and *Microcoleus*, each varying in abundance in specimens represented in several herbaria. There is evidence that the collection was made on Wolle's trip to Niagara Falls in August, 1876. Specimens seen: NEW YORK: 'Phormidium congestum', sandy deposit, Aug. 1876 (P). PENNSYLVANIA: wet wood (D, N, P, U); 'Cylindrospermum macrospermum' (O). MARYLAND: rocks, Baltimore County, *Smith*, May 1878 (P, U). SOUTH CAROLINA: *Smith*, Mar. 1878 (U); standing pools, Aiken, *Ravenel*, Oct. 1883 (PW).

References: as *Phormidium congestum* in Wolle, Bull. Torr. Club 6: 138 (1877) in part, in Tilden, Minn. Alg. 1: 118 (1910) in part; as *Cylindrospermum macrospermum* in Wolle, F. W. Alg. 292 (1887) in part; as *C. limicola* in Wolle, *loc. cit.* (1887) in part; as *C. stagnale* in Tilden, *ibid.* 198 (1910) in part; as *C. majus* in Drouet, Field Mus. Nat. Hist. Bot. Ser. 20: 6 (1939).

CYLINDROSPERMUM LICHENIFORME (Bory) Kütz. ex Born. & Flah., *ibid.* 7: 253 (1888).—Specimens seen: FLORIDA: Mar. 1878 (P); southwestern Florida, *Smith*, Mar. 1878 (U).

References: as *C. macrospermum* in Wolle, F. W. Alg. 292 (1887) in part; as *C. stagnale* in Tilden, Minn. Alg. 1: 198 (1910) in part.

CYLINDROSPERMUM MUSCICOLA Kütz. ex Born. & Flah., *ibid.* 7: 254 (1888). *C. caeruleum* Dickie ex Born. & Flah., sp. inquir., *ibid.* 7: 255 (1888).—Specimens seen: GEORGIA: salt water mud flats, Darien, *Ravenel*, Apr. 1878 (P). FLORIDA: *Smith*, Mar. 1878 (D, P, U).

### Rivulariaceae

AMPHITHRIX JANTHINA (Mont.) Born. & Flah., Ann. Sci. Nat. VII Bot. 3: 344 (1886).—Specimens seen: PENNSYLVANIA: on stones in spring water (D, P, U); 'Mastigonema caespitosum' (P).

References: as *Mastigonema caespitosum* in Wolle, Bull. Torr. Club 6: 138 (1877) in part; as *Isactis caespitosa* in Wolle, F. W. Alg. 245 (1887) in part; as *Leptothrix caespitosa* in Wolle, *ibid.* 320 (1887) in part; as *Calothrix parietina* in Tilden, Minn. Alg. 1: 269 (1910) in part.

*CALOTHRIX JULIANA* (Menegh.) Born. & Flah., *ibid.* 3: (1886).—One collection: PENNSYLVANIA: 'Geocyclus oscillarinus', river stones (D, N, P).

*CALOTHRIX PULVINATA* (Mert.) Ag. ex Born. & Flah., *ibid.* 3: 356 (1886). *Mastigonema velutinum* Wolle ex Born. & Flah., *ibid.* 5: 94 (1887), as to Wolle's specimens described and distributed, not as to the TYPE in Herb. Bornet interpreted by Bornet & Flahault?; Wolle, Bull. Torr. Club 6: 283 (1879).—Wolle's *M. velutinum* was described and later distributed in Wittr. & Nordst., Alg. exs. 388, as a plant of salt water. Bornet & Flahault, however, have placed the name as a synonym of the strictly non-marine *Scytonema guyanense*. Moreover, these authors have cited this same published isotypic material in their treatment of *Calothrix scopulorum* Born. & Flah., *ibid.* 3: 353 (1886). To dispose of the name *Mastigonema velutinum* properly we must await a reinterpretation of the specimen designated as the TYPE ('specim. auth.') in Bornet's herbarium. Specimens seen: NEW JERSEY: on wood, submarine, 1878 (original material of *M. velutinum*, N, P, U); Perth Amboy, July 1878 (Wittr. & Nordst., Alg. exs. 388, N, PW). GEORGIA: salt water creeks, Darien, *Ravenel*, Apr. 1878 (P), 308 (BM).

References: as *M. velutinum* in Wolle, Wittr. & Nordst. Alg. exs. 8: 388 (1880); as *M. aerugineum* in Wolle, F. W. Alg. 241 (1887), Britton Final Rep. Geol. N. J. 2: 603 (1889).

*CALOTHRIX PARIETINA* (Näg.) Thur. ex Born. & Flah., *ibid.* 3: 366 (1886). *Mastigothrix turgida* Wolle ex Forti, Syll. Myxophyc. 632 (1907); Wolle, Bull. Torr. Club 6: 184 (1877).—Specimens seen: MASSACHUSETTS: on stones, Woods Hole, *W. G. Farlow*, Aug. 1876 (P). NEW YORK: old boards, Niagara, Aug. 1876 (P). PENNSYLVANIA 'Pilinia diluta' (D, P); 'Mastigothrix turgida, n. sp.' (TYPE of *Mastigothrix turgida*, P; isotype, D); stones in limestone springs (D, P). FLORIDA: 'Mastigonema pluviale', Mar. 1878 (P).

References: as *Calothrix crustacea* in Wolle, F. W. Alg. 239 (1887); as *C. parietina* in Setchell, *Erythea* 7: 45 (1899); as *Mastigothrix turgida* in Tilden, *Minn. Alg.* 1: 273 (1910).

*CALOTHRIX BRAUNII* Born. & Flah., *ibid.* 3: 368 (1886). *Inactis obscura* Dickie ex Gom. sp. excl., Ann. Sci. nat. VII Bot. 15: 329 (1892); Dickie, Journ. Linn. Soc. Bot. 18: 126 (1880); Drouet, Amer. Journ. Bot. 25: 660 (1938).—Specimens seen: PENNSYLVANIA: large spring, Nazareth, July 1887 (D, PW); Derry Church, Dauphin County, Oct. 1887 (PW).

Reference: as *Isactis caespitosa* in Wolle, F. W. Alg. 244 (1877) in part.

CALOTHRIX ADSCENDENS (Näg.) Thur. ex Born. & Flah., *ibid.* 3: 365 (1886). *C. violacea* (Wolle) Forti, Syll. Myxophyc. 619 (1907). *Mastigonema violaceum* Wolle ex Forti pro. synonym., loc. cit. (1907); Wolle, Bull. Torr. Club 6: 138 (1877). *M. fuscum* Wolle ex Forti, *ibid.* 618 (1907); Wolle, loc. cit. (1877). *Calothrix Fortii* J. DeToni, Noter. Nomencl. Algol. 1: 6 (1934).—Specimens seen: PENNSYLVANIA: parasitic on *Lyngbya Wollei* and *Cladophora* (TYPES of *Calothrix violacea* and *Mastigonema fuscum*, P; isotypes, D, F).

References: as *Leptothrix parasitica* in Wolle, Bull. Torr. Club 6: 182 (1877); as *Calothrix adscendens* in Setchell, Erythea 7: 46 (1899), in Tilden, Minn. Alg. 1: 267 (1910); as *C. violacea* in Tilden, loc. cit. (1910); as *C. fusca* in Tilden, *ibid.* 265 (1910).

DICHOTHRIX HOSFORDII (Wolle) Born. apud Setchell, Erythea 4: 190 (1896). *Calothrix Hosfordii* Wolle ex Born. & Flah. sp. inquir., Ann. Sci. Nat. VII Bot. 3: 370 (1886); Wolle, Bull. Torr. Club 8: 38 (1881).—The specimen from Vermont is annotated by C. G. Pringle, fellow collector of F. H. Hosford to whom Wolle ascribes the original collection. The mass is scanty and poorly developed; the filaments are very young, but they match well young filaments in specimens distributed as *D. Hosfordii* by Prof. Setchell. The specimen from New York is a duplicate of that upon which Bornet and Setchell based the binomial *D. Hosfordii*, and which is mentioned by Setchell in Phyc. Bor.-Amer. 5: 215 (1896) as having been “referred to *Calothrix Hosfordii* by Mr. Wolle himself.” Specimens seen: VERMONT: wet rocks, La Plata River, Charlotte (F). NEW YORK: on submerged stones, Lake George, S. E. Jeliffe, Oct. 1892 (N).

References: as *Calothrix Hosfordii* in Wolle, F. W. Alg. 239 (1887); as *Dichothrix Hosfordii* in Forti, Syll. Myxophyc. 640 (1907), in Tilden, Minn. Alg. 1: 278 (1910).

DICHOTHRIX BAUERIANA (Grun.) Born & Flah., *ibid.* 3: 375 (1886).—Specimens seen: NEW JERSEY: Morris Pond, July 1879 (Wittr. & Nordst., Alg. exs. 389, N, PW). PENNSYLVANIA: ‘*Calothrix radiosa*’ (P). FLORIDA: *Smith*, Mar. 1878 (P, U). TERRITORY OF HAWAII: from rockery, Wailuku, *Hitchcock*, July 1881 (U).

References: as *Schizosiphon Bauerianus* in Wolle, Bull. Torr. Club 6: 284 (1879); as *Calothrix Orsiniana* in Wolle, Wittr. & Nordst. Alg. exs. 8: 389 (1880), Bull. Torr. Club. 8: 38 (1881); as *C. radiosa* var. *fuscescens* in Wolle, loc. cit. (1881); as *C. affinis* in Wolle, *ibid.* 9: 25 (1882); as *C. radiosa* in Wolle, F. W. Alg. 238 (1887), Britton Final Rep. Geol. N. J. 2: 603 (1889); as *Dichothrix Baueriana* in Tilden, Minn. Alg. 1: 276 (1910).

DICHOTRHX ORSINIANA (Kütz.) Born. & Flah., Ann. Sci. Nat. VII Bot. 3: 376 (1886).—One collection: NEW YORK: Niagara, Aug. 1876 (F, P).

References: as *Mastigonema Orsinianum* in Wolle, Bull. Torr. Club 6: 138 (1877); as *Dichotrix Orsiniana* in Tilden, Minn. Alg. 1: 275 (1910) in part.

RIVULARIA HAEMATITES (DC.) Ag. ex Born. & Flah., *ibid.* 4: 350 (1886).—The specimens cited here from the Farlow Herbarium were annotated by Bornet in 1899 as the marine and brackish-water species *R. Biasoletiana* Menegh. ex Born. & Flah. One collection: NEW YORK: Niagara, Aug. 1876 (F, P).

Reference: as *Zonotrichia chrysocoma* in Wolle, Bull. Torr. Club 6: 138 (1877).

GLOEOTRICHIA ECHINULATA (Born. & Flah.) Richt., Forschungsber. Biol. Sta. Plön 2: 32 (1894). *Rivularia echinulata* Engl. Bot. ex Born. & Flah., Ann. Sci. Nat. VII Bot. 4: 366 (1886).—Many papers have been written concerning why we should or should not consider *Gloeotrichia echinulata* and *G. Pisum* as distinct species; the earlier literature is reviewed by Bornet & Flahault in Bull. Soc. Bot. France 31: 76–81 (1884), by Richter (*ibid.*), by Howe in Torreyia 3: 150–154 (1903), and by others. Bornet & Flahault's work alone is based upon a comparative study of collections from many widely separated localities; these authors placed the two forms together under the name *G. Pisum*. The numerous other papers which have come to my attention contain, aside from the customary meticulous review of literature, no more than lengthy dissertations upon the morphology of the plants as they appear in water-blooms on local ponds and lakes. Intimate details of the life history of each form are still lacking. In recent studies I have had access to scarcely a hundred different collections of the two forms, living and preserved, from many parts of the world, including those seen by Bornet & Flahault, Richter, Howe, and others. At present I can find no sound morphological or ecological basis upon which to separate the two as distinct species. I retain the two names here only as a matter of convenience to indicate, as Bornet & Flahault have already suggested, what may be two extremes of habitat and growth relationship: *G. echinulata* the small form, usually planktonic, and *G. Pisum* the small or large form, known to be attached to a substratum in the juvenile state and later floating free in the water.

Wolle's notes on *Rivularia radians* var. *minutula* in Bull. Torr. Club 8: 38 (1881) should give us little doubt that he referred here to *Gloeotrichia echinulata*. However, this report is the basis of Tilden's inclusion (Minn. Alg. 1: 288) of *Rivularia minutula* (Kütz.) Born. &

Flah. in the North American flora. Specimens seen: MINNESOTA: floating in the lake, Waterville, *J. C. Arthur*, July 1882 (F), Aug. 1882 (F).

References: as *Rivularia echinulata* in Wolle, *F. W. Alg.* 249 (1887), in Tilden, *Minn. Alg.* 1: 291 (1910).

GLOEOTRICHIA PISUM (Ag.) Thur. ex Born. & Flah., *Ann. Sci. Nat. VII Bot.* 4: 366 (1886). *Rivularia Pisum* Ag. ex Born. & Flah. pro. synonym., loc. cit. (1886). *R. paradoxa* (Wolle) Forti, *Syll. Myxophyc.* 672 (1907). *Zonotrichia paradoxa* Wolle ex Forti, *ibid.* 636 (1907); Wolle, *Bull. Torr. Club* 6: 138 (1877).—In the original material of *Z. paradoxa* most of the vegetative cells have disappeared from the plants, but the remaining spores are very typical of *Gloeotrichia Pisum*. Specimens seen: PENNSYLVANIA: culms of *Sagittaria* (TYPE of *Zonotrichia paradoxa*, P; isotypes, N, U); 'Gloeotrichia-Rivularia' (P). MONTANA: Grand Coulee Creek, *F. W. Anderson*, Sept. 1889 (PW).

References: as *Zonotrichia paradoxa* in Wolle, *Bull. Torr. Club* 6: 184 (1877); as *Rivularia paradoxa* in Tilden, *Minn. Alg.* 1: 289 (1910).

GLOEOTRICHIA NATANS (Hedw.) Rabenh. ex Born. & Flah., *ibid.* 4: 369 (1886). *Rivularia natans* (Hedw.) Welw. ex Born. & Flah. pro. synonym., loc. cit. (1886). *Calothrix scytonemicola* var. *brasiliensis* Borge, *Ark. f. Bot.* 19 (17): 5 (1925). *Rivularia (Gloeotrichia) flagelliformis* Gardn., *Mem. New York Bot. Gard.* 7: 71 (1927).—Specimens seen: NEW YORK: ponds, Buffalo, Aug. 1876 (D, F, N, P, U). PENNSYLVANIA: culms in stagnant water (D, P); an *Halmen von Wasserpflanzen und Sagittaria*, Bethlehem, July 1877 (Rabenh. Alg. 2539, N, T). SOUTH CAROLINA: Santee Canal, *Ravenel* (BM).

References: as *G. natans* in Wolle, *Bull. Torr. Club* 6: 138 (1877), *F. W. Alg.* 246 (1877); as *G. Pisum* in Wolle, *Bull. Torr. Club* 6: 138 (1877), *F. W. Alg.* 247 (1887); as *G. parvula* in Wolle, Rabenh. Alg. 2539 (1878); as *Rivularia Pisum* in Tilden, *Minn. Alg.* 1: 284 (1910) in part; as *R. natans* in Tilden, *ibid.* 285 (1910).

### Scytonemataceae

FREMYELLA diplosiphon (Born. & Flah.), **comb. nov.** *Microchaete diplosiphon* Gom. ex Born. & Flah., *Ann. Sci. Nat. VII Bot.* 5: 84 (1887); Gomont, *Bull. Soc. Bot. France* 32: 211 (1885).—J. DeToni in *Noter. Nomencl. Algol.* VIII (1936) has pointed out that the generic name *Microchaete* was used to designate certain phanerogamous plants before it was proposed for a similar group of Myxophyceae. One collection: PENNSYLVANIA: pump trough (D, P).

References: as *Mastigonema paradoxum* in Wolle, *Bull. Torr. Club* 6: 184 (1877), in Tilden, *Minn. Alg.* 1: 273 (1910).

TOLYPOTHRIX LANATA (Desv.) Wartm. ex Born. & Flah., *ibid.* 5: 120 (1887). *T. bombycina* Wolle sp. nov., Bull. Torr. Club 7: 44 (1880).—Specimens seen: NEW JERSEY: Lake Hopatcong, 1879 (TYPE of *T. bombycina*, P; isotype, D). PENNSYLVANIA: on Conomitrium, July 1876 (F, P); with *Gloeotrichia Pisum* on culms of Sagittaria (P); stagnant water, Sept. 1878 (U); 'Calothrix mirabilis' (U).

References: as *T. muscicola* in Wolle, Bull. Torr. Club 6: 139 (1877), F. W. Alg. 264 (1887) in part; as *Plectonema mirabile* in Wolle, *ibid.* 266 (1887) in part; as *Tolypothrix lanata* in Tilden, Minn. Alg. 1: 230 (1910) in part.

TOLYPOTHRIX TENUIS Kütz. ex Born. & Flah., *ibid.* 5: 122 (1887). *T. rupestris* Wolle, F. W. Alg. 265 (1887), Bull. Torr. Club 6: 185 (1877); Geitler, Rabenh. Krypt.-Fl. 14: 733 (1932).—As Prof. Setchell has already pointed out in Erythea 4: 193 (1896) the original material of *T. rupestris* cannot be separated from other specimens of *T. tenuis*. Geitler (*ibid.*) has shown that a few of the filaments are broader than is usual in *T. tenuis*; it appears to me that the method of preparation of the specimens is responsible for such anomalies. The habit of the filaments in the masses bears little resemblance to that of species of *Hassallia* with which Geitler has placed *T. rupestris*. Setchell (*ibid.*) has referred part of Wolle's *T. muscicola* to *T. tenuis*. Specimens seen: MASSACHUSETTS: Woods Hole, W. G. Farlow (P). NEW JERSEY: 'T. Aegagropila' (N). PENNSYLVANIA: Delaware Water Gap, July 1878 (TYPE of *T. rupestris*, P; isotypes, D, N, O, U); in rupibus madore continuo irroratis, Delaware Water Gap, July 1879 (Rabenh. Alg. 2573, N); 'T. Aegagropila' (D, N, O, P); beech woods, July 1878 (D, P); 'Lehigh also Hopedale' (N).

References: as *T. Bulnheimii* in Wolle, Bull. Torr. Club 6: 185 (1877); as *T. rupestris* in Wolle, Rabenh. Alg. 2573 (1879), in Tilden, Minn. Alg. 1: 234 (1910); as *T. Aegagropila* in Wolle, Bull. Torr. Club 7: 44 (1880), F. W. Alg. 263 (1887), Britton Final Rep. Geol. N. J. 2: 605 (1889); as *T. tenuis* in Setchell, *loc. cit.* (1896).

HASSALLIA BYSSOIDEA (Berk.) Hass. ex Born. & Flah., Ann. Sci. Nat. VII Bot. 5: 116 (1887). *Anabaena cupressaphila* Wolle ex Forti, Syll. Myxophyc. 456 (1907); Wolle, F. W. Alg. 288 (1887). *Tolypothrix byssoidea* Kirchn. ex Forti, Syll. Myxophyc. 561 (1907); Kirchn. (the name ineffectively published), Schizophyc. 80 (1900). *Scytonema* (*Petalonema*) *junipericola* Farlow,<sup>1</sup> Phyc. Bor.-Amer. 16: 756

<sup>1</sup> The original material of this species, BERMUDA: 'Fairyland', W. G. Farlow, Jan. 1900 (TYPE, F; isotypes in Phyc. Bor.-Amer. 756, D, FM, N, T), is to be recognized at once as *Hassallia byssoidea*. In parts of the masses, the filaments have the usual aspect of this species; in other parts, the sheaths are somewhat gelatinized and the divergent lamellation is conspicuous. Geitler, Rabenh. Krypt.-Fl. 14: 797 (1932), has suggested that *Scytonema junipericola* is related to *S. mirabile* Born. (*S. figuratum* of this paper); a glance at material of the two, however, should show that such an idea is untenable.



(1900).—The TYPE of *Anabaena cupressaphila* is a mass of hormogonia of *Hassallia byssoidea*. Here also belongs, possibly, Wolle's report of *Hapalosiphon byssoideus* in F. W. Alg. 276. Specimens seen: NEW JERSEY: on red cedar, Closter (TYPE of *Anabaena cupressaphila*, P). PENNSYLVANIA: old wood, wet places (D, P); moist log at canal lock (P). SOUTH CAROLINA: on Nyssa, Aiken, *Ravenel* 137 (F); on old pine board, Aiken, *Ravenel* 201, 334 (F, P); trunks of trees, Aiken, *Ravenel* (N). GEORGIA: on pine boards and on Juniperus, *Ravenel* 387, 404 (F). TEXAS: trunks of trees, Houston, *Ravenel* (N).

References: as *Trichormus incurvus* in Wolle, Bull. Torr. Club 6: 183 (1877); as *Scytonema truncicola* in Wolle, *ibid.* 6: 284 (1879), Amer. Quart. Microsc. Journ. 1: 207 (1879); as *S. cortex* f. *Ravenelii* in Wolle, F. W. Alg. 257 (1887) as to specimens, not as to name-bearing synonym?; as *Tolypothrix truncicola* in Wolle, *ibid.* 266 (1887); as *Sirosiphon lignicola* in Wolle, *ibid.* 273 (1887) in part; as *Anabaena cupressaphila* in Wolle, Britton Final Rep. Geol. N. J. 2: 607 (1889), in Tilden, Minn. Alg. 1: 195 (1910); as *A. flos-aquae* in Tilden, *ibid.* 189 (1910) in part; as *Tolypothrix byssoidea* in Tilden, *ibid.* 233 (1910).

DIPLOCOLON HEPPII Näg. ex Born. & Flah., *ibid.* 5: 129 (1887). *Scytonema Heppii* Wolle ex Forti pro. synon., Syll. Myxophyc. 561 (1907); Wolle, F. W. Alg. 260 (1887), as to name-bearing synonym, not as to specimens.—Kossinskaja, Not. Syst. Crypt. Hort. Bot. Princip. URSS 4: 64–74 (1926), has endeavored to show that this species is really a growth form of *Scytonema crustaceum* var. *incrustans*. It is unfortunate that in making observations this author did not study also Hepp's isotypic specimens distributed in Rabenh. Alg. 468 and material of *S. crustaceum* cited by Bornet & Flahault. In the specimens treated by the monographers and those cited in the present paper, I am given the impression that the scytonematoid filaments of the two species are easily distinguished by the nature of the lamellation of the sheaths, as indicated in Bornet & Flahault's descriptions. It would be hazardous to suggest a union of the two species, as both Kossinskaja (*ibid.*) and Geitler, Rabenh. Krypt.-Fl. 14: 782 (1932), have done, at least upon the basis of the few collections now on file in herbaria. Specimens seen: NEW YORK: Niagara, Aug. 1876 (F, P).

References: as *Diplocolon Heppii* in Wolle, Bull. Torr. Club 6: 139 (1877), in Setchell, Erythraea 4: 193 (1896), in Tilden, Minn. Alg. 1: 236 (1910) in part, in Smith, Freshw. Alg. U. S. 97 (1933) in part.

SCYTONEMA ALATUM (Berk.) Borzi ex Born. & Flah., Ann. Sci. Nat. VII Bot. 5: 110 (1887). *Petalonema alatum* Berk. ex Born. & Flah. pro. synon., loc. cit. (1887).—Specimens seen: NEW YORK: Niagara, Aug. 1876 (F, P).

References: as *Scytonema alatum* in Setchell, Erythraea 4: 193 (1896), in Tilden, Minn. Alg. 1: 225 (1910); as *Petalonema alatum* in Wolle, F. W. Alg. 267 (1887).

SCYTONEMA DENSUM (A. Br.) Born. & Flah., *ibid.* 5: 109 (1887). *S. evanescens* Gardn.,<sup>1</sup> *Mem. New York Bot. Gard.* 7: 71 (1927). *Petalonema densum* Mig. ex Geitler, *Rabenh. Krypt.-Fl.* 14: 793 (1932).—Specimens seen: NEW YORK: wet moss and wood, old boards, Niagara, Aug. 1876 (F, P).

References: as *Scytonema tolypotrichoides* in Wolle, *Bull. Torr. Club* 6: 139 (1877) in part, *F. W. Alg.* 250 (1887); as *Symphysiphon incrustans* in Wolle, *Bull. Torr. Club* 6: 139 (1877) in part; as *S. Contarenii* in Wolle, *loc. cit.* (1877); as *Scytonema densum* in Setchell, *Erythea* 4: 191 (1896), in Tilden, *Minn. Alg.* 1: 227 (1910).

SCYTONEMA CRUSTACEUM (Ag.) Born. & Flah., *ibid.* 5: 106 (1887). *S. crustaceum* var. *incrustans* (Kütz.) Born. & Flah., *ibid.* 5: 107 (1887). *S. mirabile* Wolle, *F. W. Alg.* 255 (1887), *Bull. Torr. Club* 6: 217 (1878), *ibid.* 6: 384 (1879), not Born. *S. Wolleanum* Forti, *Syll. Myxophyc.* 513 (1907). *Petalonema crustaceum* Kirchn. ex Forti pro. *synon.*, *ibid.* 525 (1907); Kirchner (the name ineffectively published), *Schizophyc.* 79 (1900).—Bornet & Flahault (*ibid.*) must have made a typographical error in placing Wolle's report of *Symphysiphon incrustans* instead of his *Scytonema mirabile* in synonymy with their *S. crustaceum* var. *incrustans*. Setchell in *Erythea* 4: 191 (1896) pointed out this error long before Forti proposed the superfluous name *S. Wolleanum* for *S. mirabile* Wolle instead of for its later homonym, *S. mirabile* (Dillw.) Born. (see *S. figuratum* of this paper). Specimens seen: SOUTH CAROLINA: Aiken, *Ravenel* 109, 351 (F). FLORIDA: Gainesville, *Ravenel* (TYPE of *S. mirabile* Wolle, P; isotype, F); Smith, Mar. 1878 (P, U).

References: as *Schizosiphon cataractae* in Wolle, *Bull. Torr. Club* 6: 284 (1879); as *Scytonema Heppii* in Wolle, *F. W. Alg.* 260 (1887); as *S. crustaceum* var. *incrustans* in Setchell, *loc. cit.* (1896), in Tilden, *Minn. Alg.* 1: 226 (1910); as *S. Wolleanum* in Tilden, *ibid.* 221 (1910), in Geitler, *Rabenh. Krypt.-Fl.* 14: 787 (1932); as *Diplocolon Heppii* in Tilden, *ibid.* 236 (1910) in part, in Smith, *Freshw. Alg. U. S.* 97 (1933) in part.

SCYTONEMA MYOCHROUS (Dillw.) Ag. ex Born. & Flah., *Ann. Sci. Nat. VII Bot.* 5: 104 (1887). *S. cataracta* Wood ex Born. & Flah. pro. *synon.*, *ibid.* 5: 105 (1887); Wood, *Proc. Amer. Philos. Soc.* 11: 129 (1869). *S. Brandegeei* Wolle ex Born. & Flah. sp. *inquir.*, *ibid.* 5: 111 (1887); Wolle, *Bull. Torr. Club* 6: 184 (1877).—Wolle described the filaments of *S. Brandegeei* as 38–42  $\mu$  in diameter, but I find none

<sup>1</sup> The TYPE of *S. evanescens* in the New York Botanical Garden, PUERTO RICO: on limestone, Arecibo to Utuado, *Wille* 1482, should without hesitation be referred to *S. densum* in spite of Geitler's suggestion in *Rabenh. Krypt.-Fl.* 14: 785 (1932) that *S. evanescens* is an ecological or growth form of *S. Myochrous*. However, other specimens cited with Gardner's description are lichenized masses of *S. Myochrous*.

in the original material exceeding  $35\ \mu$  in diameter. Specimens seen: NEW YORK: Niagara, Aug. 1876 (F, P; Rabenh. Alg. 2492, N). NEW JERSEY: with *S. figuratum*, Morris Pond (P). PENNSYLVANIA: Bethlehem, 1874, 1875 (F); moist rocks, 1877 (N, U); Rockdale, 1883 (P). COLORADO: wet rocks (TYPE of *S. Brandegeei*, P, isotype, N).

References: as *S. Hegetschweileri* in Wolle, Bull. Torr. Club 6: 139 (1877) in part, *ibid.* 6: 284 (1879); as *S. cataracta* in Wolle, Rabenh. Alg. 2492 (1877) in part, F. W. Alg. 252 (1887); as *S. Myochrous* in Wolle, loc. cit. (1887), Britton Final Rep. Geol. N. J. 2: 605 (1889), in Setchell, Erythea 4: 192 (1896), in Tilden, Minn. Alg. 1: 224 (1910).

SCYTONEMA FIGURATUM Ag. ex Born. & Flah., *ibid.* 5: 101 (1887). *S. Austinii* Wood ex Born. & Flah. sp. inquir., *ibid.* 5: 111 (1887); Wood, Smiths. Contrib. Knowl. 241: 58 (1872). *Symphysiphon Austinii* Wood apud Wolle, F. W. Alg. 261 (1887). *Scytonema gracile* var. *tolypotrichoides* Wittr. ex Born. & Flah. sp. inquir., loc. cit. (1887); Wolle in Wittr. & Nordst. Alg. exs. 8: 389 (1880), Bull. Torr. Club. 8: 38 (1881). *S. mirabile* Born., Bull. Soc. Bot. France 36: 155 (1889), not Wolle.—See notes under *S. crustaceum* of this paper. The isotype of *S. Austinii* cited here bears the note in Francis Wolle's handwriting: "Same as sent to Dr. Wood" [by C. F. Austin]. Specimens seen: NEW YORK: Niagara, 1876 (P; Rabenh. Alg. 2492, N). NEW JERSEY: Morris Pond, July 1879 (TYPE of *S. gracile* var. *tolypotrichoides*, Wittr. & Nordst. Alg. exs. 389, PW; isotype, N); with *Stigonema ocellatum*, old path, Closter, Nov. 1877 (P). PENNSYLVANIA: Bethlehem (F). NORTH CAROLINA: Warren Springs, French Broad River, Smith, Aug. 1880 (U). SOUTH CAROLINA: Aiken, on the ground, Ravenel 545 (PW), logs under water, Ravenel 472, 475 (F, PW), damp face of clay cliff, Ravenel 82 (BM), wet timber at Benton's old mill, Ravenel 111, 113 (BM). FLORIDA: Smith, Mar. 1878 (U).

References: as *S. Hegetschweileri* in Wolle, Bull. Torr. Club 6: 139 (1877) in part; as *S. cataracta* in Wolle, Rabenh. Alg. 2492 (1877) in part; as *S. Notarisii* in Wolle, Bull. Torr. Club 6: 284 (1879); as *S. polymorphum* in Wolle, loc. cit. (1879), F. W. Alg. 255 (1887) in part; as *S. turfosum* in Wolle, Bull. Torr. Club 6: 284 (1879), Amer. Quart. Microsc. Journ. 1: 207 (1879), F. W. Alg. 253 (1887); as *S. simplex* in Wolle, *ibid.* 259 (1887), in Tilden, Minn. Alg. 1: 229 (1910); as *S. tolypotrichoides* in Wolle, Britton Final Rep. Geol. N. J. 2: 604 (1889), in Setchell, Erythea 4: 192 (1896), in Tilden, *ibid.* 222 (1910); as *S. mirabile* in Setchell, *ibid.* 4: 193 (1896), in Tilden, loc. cit. in part (1910); as *S. Austinii* in Tilden, *ibid.* 220 (1910), in Geitler, Rabenh. Krypt.-Fl. 14: 759 (1932).

SCYTONEMA TOLYPOTRICHOIDES Kütz. ex Born. & Flah., *ibid.* 5: 100 (1887).—This species passes under the name *S. Archangelii* in recent North American phycological literature. Specimens seen: NEW JERSEY: '*S. calotrichoides*' (U); pond (O); Browns Mills, 1879

(D, P). MARYLAND: Falls of Deep Creek, Garrett County, *Smith*, July 1878 (P). FLORIDA: *Smith*, Mar. 1878 (P, U).

References: as *Schizosiphon Meneghinianus* in Wolle, Bull. Torr. Club 6: 284 (1879); as *Calothrix mirabilis* in Wolle, *ibid.* 6: 285 (1879); as *C. Meneghiniana* in Wolle, F. W. Alg. 238 (1887); as *Scytonema calotrichoides* f. *natans* in Wolle, *ibid.* 251 (1887); as *S. natans* in Wolle, *ibid.* 252 (1887), Britton Final Rep. Geol. N. J. 2: 605 (1889); as *Plectonema mirabile* in Wolle, F. W. Alg. 266 (1887) in part; as *Scytonema calotrichoides* of Wolle, Britton Final Rep. Geol. N. J. 2: 605 (1889); as *S. tolypotrichoides* in Drouet, Field Mus. Nat. Hist. Bot. Ser. 20: 7 (1939); as *Dichothrix Meneghiniana* in Tilden, *ibid.* 277 (1910) in part.

SCYTONEMA HOFMANNII Ag. ex Born. & Flah., Ann. Sci. Nat. VII Bot. 5: 97 (1887). *S. cortex* Wood ex Born. & Flah. pro. synonym., *ibid.* 98 (1887); Wood, Proc. Amer. Philos. Soc. 11: 130 (1869). *Sirosiphon scytonematoides* Wood ex Born. & Flah. pro. synonym., *ibid.* 117 (1887); Wood, *ibid.* 134 (1869). *Scytonema cortex* f. *corrugatum* Wolle, F. W. Alg. 257 (1887). *S. cortex* f. *brunneum* Wolle, *ibid.* 258 (1887). *S. Hofmannii* f. *brunneum* Wolle apud Forti, Syll. Myxophyc. 515 (1907).—The many specimens in the Farlow Herbarium referred by Wood and Ravenel to *Sirosiphon scytonematoides* consist of the same types of swollen and lichenized filaments as those which occur in the material labeled *Scytonema cortex* f. *corrugatum* by Wolle. Bornet & Flahault (*ibid.*), however, have placed Wood's *Sirosiphon scytonematoides* in synonymy with their *Hassallia byssoidea*. In the present study, which has involved an examination of a large series of this lichenized form from southern United States, the West Indies, and Central America, it has seemed more reasonable to refer it to *Scytonema Hofmannii*. Specimens seen: NEW YORK: Haverstraw, *Austin*, Oct. 1869 (P); Niagara, Aug. 1876 (P). NEW JERSEY: on stones in damp woods, Closter, *Austin* (P). SOUTH CAROLINA: on bark of *Platanus occidentalis*, *Ravenel* 47 (ISOTYPE of *Scytonema cortex*, F); Aiken, *Ravenel* 137 (F), 211 (BM), 222, 241 (F), clay cliffs, *Ravenel* 218 (F). GEORGIA: bark, red cedar, *Ravenel*, Apr. 1878 (P); on Juniperus, Darien, *Ravenel* 292, 322, (F); on oak, Darien, *Ravenel* 306 (F). FLORIDA: St. Lucian River, *Smith*, Mar. 1878 (P); on *Myrica cerifera*, *Ravenel* 10 (ISOTYPE of *Sirosiphon scytonematoides*, P), 37 (BM); *Smith*, Mar. 1878 (TYPE of *Scytonema cortex* f. *corrugatum*, P; isotype, U).

References: as *S. chrysochlorum* in Wolle, Bull. Torr. Club 6: 139 (1877) in part; as *S. cortex* var. *corrugatum* 'var. nov.' in Wolle, *ibid.* 6: 284 (1879); as *S. cortex* var. *brunneum* 'var. nov.' in Wolle, loc. cit. (1879); as *S. cortex* in Wolle, F. W. Alg. 256 (1887); as *S. tomentosum* in Wolle, *ibid.* 262 (1887), Britton Final Rep. Geol. N. J. 2: 605 (1889); as *Sirosiphon scytonematoides* in Wolle, F. W. Alg. 271 (1887); as *Scytonema Hofmannii* in Tilden, Minn. Alg. 1: 216 (1910); as *S. Hofmannii* f. *brunneum* in Tilden, *ibid.* 217 (1910).

SCYTONEMA VARIUM Kütz. ex Born. & Flah., *ibid.* 5: 97 (1887).—Specimens seen: PENNSYLVANIA: '*S. chrysochlorum*' (D, P); Bushkill, 1875 (P). FLORIDA: Fort Meade, *Smith*, May 1880 (U).

References: as *S. chrysochlorum* in Wolle, F. W. Alg. 253 (1887) in part; as *S. varium* in Tilden, Minn. Alg. 1: 217 (1910) in part.

SCYTONEMA OCELLATUM Lyngb. ex Born. & Flah., *ibid.* 5: 95 (1887).—Specimens seen: NEW JERSEY: dry rocks, Goodwinsville, *Austin*, 1869 (P). PENNSYLVANIA: clay banks, Oct. 1875 (P). GEORGIA: on old bricks etc., Darien, *Ravenel* 449, Nov. 1881 (F); on oak, Darien, Mar. 1881 (BM).

References: as *S. Naegelii* in Wolle, Bull. Torr. Club 6: 184 (1877), F. W. Alg. 252 (1887), Britton Final Rep. Geol. N. J. 2: 604 (1889); as *S. cinereum* in Wolle, Bull. Torr. Club 6: 184 (1877), F. W. Alg. 253 (1887), Britton Final Rep. Geol. N. J. 2: 605 (1889); as *S. ocellatum* in Tilden, Minn. Alg. 1: 218 (1910); as *Tolypothrix penicillata* in Tilden, *ibid.* 232 (1910) in part.

SCYTONEMA GUYANENSE (Mont.) Born. & Flah., Ann. Sci. Nat. VII Bot. 5: 94 (1887). *Symphysiphon Wollei* Born. ex Born. & Flah. pro. synonym., loc. cit. (1887); Bornet in Wolle, Bull. Torr. Club 6: 139 (1877). *Scytonema guyanense* var. *minus* Gardn., Mem. New York Bot. Gard. 7: 79 (1927).—See notes under *Calothrix pulvinata* of this paper. Specimens seen: PENNSYLVANIA: Oct. 1876 (F); on limestone rocks, Depot Hill, Oct. 1874 (ISOTYPES of *Symphysiphon Wollei*, F, N, P). SOUTH CAROLINA: on *Acer rubrum*, Aiken, *Ravenel* 176 (F); base of Nyssa, Aiken, *Ravenel* 70 (F).

Reference: as *S. guyanense* in Tilden, Minn. Alg. 1: 220 (1910).

SCYTONEMA STUPOSUM (Kütz.) Born. ex Born. & Flah., *ibid.* 5: 92 (1887). *S. caldarium* Setch., *Erythea* 7: 48 (1899). *S. azureum* Tild.,<sup>1</sup> Amer. Alg. 7: 630 (1909).—Specimens seen: FLORIDA: *Smith*, Mar. 1878 (U). JAMAICA: '*Jamaica*' (P).

References: as *S. intertextum* in Wolle, Bull. Torr. Club 6: 284 (1879), F. W. Alg. 258 (1887), in Tilden, Minn. Alg. 1: 219 (1910).

SCYTONEMA CININNATUM (Kütz.) Thur. ex Born. & Flah., *ibid.* 5: 89 (1887). *S. crispum* (Ag.) Born., Bull. Soc. Bot. France 36: 157 (1889).—Specimens seen: PENNSYLVANIA: Quakertown (P); '*Lyngbya cincinnata*' (U); stagnant water (O); 1880 (N). FLORIDA: *Smith*, Mar. 1878 (U).

References: as *S. cincinnatum* in Wolle, Bull. Torr. Club 8: 38 (1881), F. W. Alg. 254 (1887); as *Tolypothrix distorta* in Wolle, *ibid.* 263 (1887) at least in part, Tilden, Minn. Alg. 1: 231 (1910) in part; as *Lyngbya cincinnata* in Wolle, *ibid.* 296 (1887) in part; as *Scytonema crispum* in Tilden, *ibid.* 214 (1910).

<sup>1</sup> I cannot distinguish the isotypes of these two species from other specimens of *S. stuposum*: CALIFORNIA: Waterman Hot Springs, San Bernardino, *S. B. Parish*,

## Oscillatoriaceae

PORPHYROSIPHON NOTARISII (Menegh.) Kütz. ex Gom., Ann. Sci. Nat. VII Bot. 15: 331 (1892); Drouet, Amer. Journ. Bot. 24: 601 (1937). *Scytonema Kaernbachii* Henn., Bot. Jahrb. 15 (Beibl. 33): 8 (1892). *Microcoleus Ravenelii* Wolle ex Gom. sp. inquirend., ibid. 15: 361 (1892); Wolle, F. W. Alg. 307 (1887). *Porphyrosiphon Kaernbachii* De Toni, Nuova Notar. 3: 134 (1892). *Lyngbya Notarisii* Wille ex Forti pro. synonym., Syll. Myxophyc. 314 (1907). *Hydrocoleum Ravenelii* Wolle ex Forti, ibid. 322 (1907); Wolle, Bull. Torr. Club 6: 183 (1877). *Lyngbya arboricola* Brühl & Bisw., Journ. Dept. Sci. Univ. Calcutta 5 (Bot. 1): 7 (1923). *L. dendrobia* Brühl & Bisw., ibid. 8 (1923). *L. splendens* Gardn., Mem. New York Bot. Gard. 7: 40 (1927). *Porphyrosiphon Notarisii* var. *major* Gardn., ibid. 41 (1927). *P. robustus* Gardn., loc. cit. (1927). *Phormidium durum* Gardn.,<sup>1</sup> ibid. 45 (1927).—Wolle's specimen bearing the label 'Hydrocoleum heterotrichum' (apparently the basis for the sole report of this species from North America) consists of a mass of rather poorly preserved algae of which the principal species are *Hapalosiphon pumilus*, *Schizothrix Muellerei*, and *Porphyrosiphon Notarisii*. The published description and figure and the annotation "with *H. versicolor*" on the label prove beyond doubt that Wolle referred to the last species as *Hydrocoleum heterotrichum*. In my recent treatment of the Brazilian flora in Amer. Journ. Bot., vols. 24 and 25, I discussed the synonymy of *Porphyrosiphon Notarisii* displayed above and listed, among others, American specimens from North Carolina, South Carolina, Florida, Missouri, Texas, Puerto Rico, Cuba, Jamaica, Ceará, Maranhão, Pará, Venezuela, and Ecuador. Additional American material, along with that seen by Francis Wolle, is given here: NEW JERSEY: dryish ground along an unfrequented part of an old field, Closter, *Austin*, 1864 (P), 1866 (F). PENNSYLVANIA: from swamp near Bethlehem (P); marsh pool below Nisky (PW). VIRGINIA: Prince Edward County, *Smith*, Apr. 1878 (U). NORTH CAROLINA: Winston-Salem, *L. D. de Schweinitz* (Pa). SOUTH CAROLINA: on damp earth, Aiken, *Ravenel* 33 (N), 59 (F), 188 (BM). FLORIDA: *Smith*, Mar. 1878 (P, PW, U); on ground in sandy places, Gainesville, *Ravenel* 5, 7, 20, 29 (F, N, P). LOUISIANA:

Apr. 1897 (ISOTYPES OF *S. caldarium* Setch., Phyc. Bor.-Amer. 559, FM, T). TERRITORY OF HAWAII: "warm spring," Puna, Hawaii, *J. E. Tilden*, July 1900 (ISOTYPE OF *S. azureum*, Tild., Amer. Alg. 630, FM).

<sup>1</sup> The TYPE of *Phormidium durum* in the New York Botanical Garden, PUERTO RICO: on shaded rocks near Hacienda Catalina near Palmer, *Wille* 746, Jan. 1915, is typical material of *Porphyrosiphon Notarisii*.

on ground in swampy wood, *A. B. Langlois*, Sept. 1891 (U); on damp soil, Albany, *G. W. Prescott*, June 1938 (D). NEBRASKA: on wet and dripping sandstone, Weeping Water, *T. A. Williams*, Mar. 1888 (U). KANSAS: on soil in scrub oak woodland, Chautauqua, *W. E. Booth* 1, July 1939 (FM). OKLAHOMA: in an abandoned field, Stroud, Lincoln County, *Booth* 5, July 1939 (FM). TEXAS: on ground in pasture, Houston, *Ravenel* (TYPE of *Microcoleus Ravenelii*, P; isotypes, F, N). BAHAMA ISLANDS: Maidenhead Coppice, New Providence, *E. G. Britton* 3244, Feb. 1905 (N), *L. J. K. Brace* 9916, Jan. 1919 (N). JAMAICA: with *Scytonema Hofmannii*, Castleton, *J. E. Humphrey*, Apr. 1893 (G); *Arntully*, *C. R. Orcutt* 2708, 7021, 1927–28 (D, F, N, U); trail to Cinchona, *Orcutt* 5501, 1928 (D, F, N, U); headwaters of Buff River, *Orcutt* 3793 (D, F, N, U). SURINAM: *Christoph Weigelt* in herb. Schweinitz<sup>1</sup> (Pa).

References: as *Hypheothrix pallida* in Wolle, Bull. Torr. Club 6: 182 (1877), in Tilden, Minn. Alg. 1: 144 (1910); as *Hydrocoleum phormidioides* in Wolle, *ibid.* 6: 183 (1877) in part; as *H. heterotrichum* in Wolle, *ibid.* 6: 283 (1879) in part, in Tilden, *ibid.* 138 (1910) in part, in Smith, Freshw. Alg. U. S. 84 (1933) in part; as *Phormidium Naveanum* in Wolle, loc. cit. (1879), in Tilden, *ibid.* 102 (1910); as *Scytonema polymorphum* in Wolle, *ibid.* 6: 284 (1879), F. W. Alg. 255 (1887) in part; as *S. Notarisii* in Wolle, Bull. Torr. Club 6: 284 (1879) in part; as *Lyngbya Naveana* in Wolle, F. W. Alg. 298 (1887); as *L. pallida* in Wolle, loc. cit. (1887), Britton Final Rep. Geol. N. J. 2: 608 (1889); as *Microcoleus heterotrichus* f. *americanus* in Wolle, F. W. Alg. 307 (1887) in part; as *Oscillaria Froelichii* var. *neglecta* in Wolle, *ibid.* 316 (1887) in part; as *Hydrocoleum Ravenelii* in Tilden, *ibid.* 138 (1910), in Geitler, Rabenh. Krypt.-Fl. 14: 1154 (1932); as *Porphyrosiphon Notarisii* in Smith, *ibid.* 82 (1933) in part.

SCHIZOTHRIX PURPURASCENS var. CRUENTA (Lespin.) Gom., Ann. Sci. Nat. VII Bot. 15: 321 (1892). *Hydrocoleum rufescens* Gardn., Mem. New York Bot. Gard. 7: 57 (1927).—This is one of the several species comprising the material distributed by Wolle as *Phormidium congestum*: see under *Cylindrospermum majus* of this paper. Specimens seen: NEW YORK: sandy deposit, Aug. 1876 (F). NEW JERSEY: with *Stigonema ocellatum* on old path, Closter, Nov. 1877 (P). PENNSYLVANIA: with *Schizothrix Muelleri* on old wood, Rockdale, Aug. 1877 (P). SOUTH CAROLINA: ground in woods, Aiken, *Ravenel* 186 (BM), 500, Nov. 1883 (PW). FLORIDA: *Smith*, Mar. 1878 (P, U).

References: as *Lyngbya Phormidium* in Wolle, F. W. Alg. 299 (1887) in part; as *Microcoleus terrestris* in Wolle, *ibid.* 305 (1887) in part; as *M. vaginatus* in Tilden, Minn. Alg. 1: 157 (1910) in part.

<sup>1</sup> Dr. Barnhart's surmise (Mem. Torr. Bot. Club 16: 250, footnote. 1921) that the Surinam plants of the Schweinitz herbarium were of the collection of Christoph Weigelt and were communicated to Dr. L. D. de Schweinitz by Dr. Constantine Hering appears to be correct. In the manuscript catalogue of the

SCHIZOTHRIX LAMYI Gom., *ibid.* 15: 323 (1892).—Specimens seen: SOUTH CAROLINA: Aiken, *Ravenel* 216, 284, Feb. 1878 (F, P), 154 (BM).

References: as *Microcoleus terrestris* in Wolle, F. W. Alg. 305 (1887) in part; as *M. vaginatus* in Tilden, *Minn. Alg.* 1: 157 (1910) in part.

SCHIZOTHRIX Wollei, **nom. nov.** *Microcoleus pulvinatus* Wolle ex Gom. sp. *inquir.*, *Ann. Sci. Nat. VII Bot.* 15: 361 (1892); Wolle, F. W. Alg. 305 (1887). Stratum molle, expansum, aerugineum aut fuscum, lapides et plantas aquaticas investiens, usque ad 5 cm.

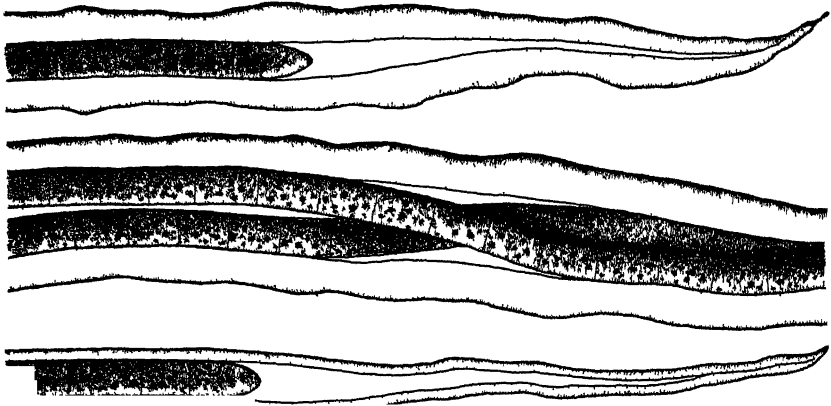


FIGURE 1. *Schizothrix Wollei* Drouet: upper ends of filaments.

altum, filis elongatis, substrictis aut subflexuosis, penicillatim aggregatis, fasciculatim pseudo-ramosis pseudo-ramis subadpressis, inferne subsimplicibus; vaginis hyalinis demum luteolis, non aut modice lamellosis, chlorozincico iodurato pulchre caerulescentibus, ambitu irregularibus aut erosis, frequenter (in speciminibus siccis) transverse plicatis, crassis vel in statu juvenili tenuibus cylindraceutis; trichomatibus aerugineis, ad genicula non aut leviter constrictis,  $4\ \mu$  ad  $6\ \mu$  crassis, plerumque intra vaginam singulis binisve aut ad bases florum usque ad quinqueis, apice non aut leviter attenuata; articulis diametro trichomatis longioribus, raro subquadratis,  $3.5\ \mu$  ad  $10\ \mu$  longis; protoplasmate dense grosse-granuloso, dissepimentis haud granulatis; cellula apicali rotundata vel obtuse conica (v. s.). **Fig. 1.**—This species is easily recognizable among others of the section *Chromosiphon* Gom. by its aquatic habit, the resemblance of its

Schweinitz collection at the Academy of Natural Sciences, Philadelphia, occurs a list of Schweinitz's correspondents. Here we find the entry: "Hering, Dr. Surinam—innumerae Weigelt collect."



filaments to those of *Schizothrix Friesii*, and its sheaths which become thick and yellow-brown in age. Visits to the type locality, the mill-race at Bamber Lake, Ocean County, New Jersey, by Dr. Ruth Patrick, Dr. Charles Hodge, and myself in early winter have failed to discover the species in the living condition. It has fortunately appeared in recent collections by Miss Joan Bader at a station not far distant. Specimens seen: NEW JERSEY: "attached to stones and larger aquatic plants in rapidly running water," Bamber, Sept. 1882 (TYPE in Herb. Univ. Pennsylvania; isotype, D); gelatinous layer in swamp, shallow water, Toms River, *J. E. Bader* 221, Oct. 1938 (FM). PENNSYLVANIA?: 'Hydrocoleum tinctorium' (P); 'in Pennsylvania' (Witttr. & Nordst. Alg. exs. 869b, N, PW).

References: as *Hydrocoleum tinctorium* in Wolle, Bull. Torr. Club 6: 183 (1877); as *Sligonema ocellatum* & *Hapalosiphon pumilus* in Wolle, Witttr. & Nordst. Alg. exs. 18: 869b (1889); as *Microcoleus pulvinatus* in Wolle, Britton Final Rep. Geol. N. J. 2: 609 (1889), in Forti, Syll. Myxophyc. 379 (1907), in Tilden, Minn. Alg. 1: 158 (1910); as *Inactis tinctoria* in Tilden, *ibid.* 149 (1910) in part.

SCHIZOTHRIX MUELLERI Näg. ex Gom., *ibid.* 15: 321 (1892). *Hydrocoleum Hieronymii* Richt., Hauck & Richt. Phyk. univ. 543 (1892).—Some of the specimens marked 'Dasygloea amorpha' are excellently preserved material of *Schizothrix Muelleri*; others contain masses of shrunken hormogonia which, though scarcely recognizable at first sight, cannot but be referred to this species also. The specimen from New York cited here is part of the material labeled *Phormidium congestum* by Wolle: see under *Cylindrospermum majus* of this paper. Specimens seen: NEW YORK: sandy deposit, August 1876, with *Microcoleus lacustris* and *Schizothrix purpurascens* (C, F). NEW JERSEY: Austin (P). PENNSYLVANIA: old wood, Rockdale, Aug. 1877 (P); Glen Onoko, Mt. Glen (D, F, N, O, P, U). MARYLAND: with *Schizothrix Friesii*, Falls of Deep Creek, Garrett County, Smith, July 1878 (U).

References: as *Hydrocoleum versicolor* in Wolle, Bull. Torr. Club 6: 138 (1877); as *Dasygloea amorpha* in Wolle, *ibid.* 6: 183 (1877), in Tilden, Minn. Alg. 1: 154 (1910), in Smith, Freshw. Alg. U. S. 85 (1933); as *Hydrocoleum phormidioides* in Wolle, *loc. cit.* (1877) in part; as *Phormidium fasciculatum* in Wolle, *ibid.* 6: 283 (1879); as *Lyngbya Phormidium* in Wolle, F. W. Alg. 299 (1877) in part; as *Microcoleus amorpha* in Wolle, *ibid.* 304 (1887); as *Schizothrix Muelleri* in Tilden, *ibid.* 152 (1910), in Drouet, Field Mus. Nat. Hist. Bot. Ser. 20: 7 (1939).

SCHIZOTHRIX CHALYBEA (Kütz.) Gom., *ibid.* 15: 319 (1892).—For notes on the distribution of this species see Drouet, Bull. Torr. Club 64: 603 (1937). One specimen: FLORIDA: with *Scytonema crustaceum*, Smith, Mar. 1878 (P).

SCHIZOTHRIX FRIESII (Ag.) Gom., Ann. Sci. Nat. VII Bot. 15: 316 (1892). *Symplocastrum Friesii* Kirchn. ex Forti, Syll. Myxophyc. 347 (1907); Kirchn. (the name ineffectively published), Schizophyc. 68 (1900). *Schizothrix Purcellii* Proc. Acad. Nat. Sci. Phila. 80: 91 (1928). *Symplocastrum Brittoniae* Gardn., New York Acad. Sci. Sci. Surv. Puerto Rico 8: 287 (1932).—Specimens seen: CANADA: *Macoun* (P). NEW YORK: Suffern, *E. B.* (P). NEW JERSEY: *Austin* (P); on the ground, Hoboken, *N. L. B. & E. G. L.*, Oct. 1884 (N, PW); Closter, *Austin* 399, 401, 455, (F, P); with *Stigonema ocellatum*, old path, Closter, Nov. 1877 (P). PENNSYLVANIA: clay banks (P, U); Lehigh Mt., Aug. 1884 (PW); 1875 (P); Sept. 1876 (F); shaded banks (N). MARYLAND: Falls of Deep Creek, Garrett County, *Smith*, July 1878 (P, U); Spesutie Island, Harford County, *Smith*, Oct. 1878 (P, U). SOUTH CAROLINA: damp clay, Aiken, *Ravenel* 219, 244, 245, 448 (F), Sept. 1869 (BM). FLORIDA: *Smith*, Mar. 1878 (P).

References: as *Symploca lucifuga* in Wolle, Bull. Torr. Club 6: 138 (1877) F. W. Alg. 303 (1887), Britton Final Rep. Geol. N. J. 2: 608 (1889) in part; as *Phormidium lyngbyaceum* in Wolle, Bull. Torr. Club 6: 183 (1877) in part; as *Symploca Friesiana* in Wolle, loc. cit. (1877), F. W. Alg. 304 (1887); as *Phormidium rupestre* in Wolle, Bull. Torr. Club 6: 283 (1879); as *Symploca fuscescens* in Wolle, loc. cit. (1879), F. W. Alg. 304 (1887), in Tilden, Minn. Alg. 1: 131 (1910); as *Lyngbya Phormidium* in Wolle, ibid. 299 (1887), Britton Final Rep. Geol. N. J. 2: 608 (1889) in part; as *L. Retzii* in Wolle, F. W. Alg. 302 (1887) in part; as *Phormidium Retzii* in Tilden, ibid. 102 (1910) in part; as *Schizothrix Friesii* in Tilden, ibid. 146 (1910).

SCHIZOTHRIX ARENARIA (Berk.) Gom., ibid. 15: 312 (1892). *Hypheothrix aikenensis* Wolle ex Forti, Syll. Myxophyc. 329 (1907); Wolle, Bull. Torr. Club 6: 182 (1877). *H. arenaria* Forti, ibid. 342 (1907). *Schizothrix aikenensis* Philson, Journ. Elisha Mitchell Sci. Soc. 55: 96 (1939).—Specimens seen: NEW JERSEY: Closter, 1864 (P), 1871 (F, P). SOUTH CAROLINA: sluggish pools, Aiken, *Ravenel* 243 (TYPE of *H. aikenensis*, P), 465 (PW); wet ground, Aiken, *Ravenel* 242, 254, 286 (F); on wet wood, Aiken, *Ravenel* 472, Nov. 1881 (F). FLORIDA: *Smith*, Mar. 1878 (P).

References: as *Microcoleus terrestris* in Wolle, Bull. Torr. Club 6: 138 (1877), F. W. Alg. 305 (1887), Britton Final Rep. Geol. N. J. 2: 609 (1889), in part; as *Hypheothrix coriacea* f. *Meneghinii* in Wolle, Bull. Torr. Club 6: 182 (1877), in Tilden, Minn. Alg. 1: 142 (1910); as *Scytonema thermale* in Wolle, F. W. Alg. 259 (1887) in part; as *Hypheothrix aikenensis* in Tilden, ibid. 141 (1910); as *Microcoleus vaginatus* in Tilden, ibid. 157 (1910) in part.

SCHIZOTHRIX LARDACEA (Ces.) Gom., ibid. 15: 307 (1892). *Hypheothrix lardacea* Hansg., Dalla Torre & Sarnth. Fl. Tirol Verarlb. & Liechtenst. 2: 144 (1901).—Specimens seen: PENNSYLVANIA: Rock-

dale, Aug. 1877 (P). TERRITORY OF HAWAII: 'Sandwich Islands' (PW).

References: as *H. turicensis* in Wolle, Bull. Torr. Club 6: 182 (1877), in Tilden, Minn. Alg. 1: 141 (1910).

SCHIZOTHRIX CALCICOLA (Ag.) Gom., *ibid.* 15: 307 (1892). *Hypheothrix calcicola* Rabenh. ex Gom. pro. synonym., loc. cit. (1892).—Specimens seen: PENNSYLVANIA: greenhouse, July 1877 (D, P); June 1876 (P); 'Oscillaria chlorina' (P). VIRGINIA: Petersburg, *Smith*, Apr. 1878 (U). SOUTH CAROLINA: artesian wells, *Smith*, Mar. 1878 (P, U). GEORGIA: on brick walls, Savannah, *Ravenel* (P).

References: as *Oscillaria tenerrima* in Wolle, Bull. Torr. Club 6: 138 (1877), F. W. Alg. 309 (1887), in part; as *Leptothrix muralis* in Wolle, Bull. Torr. Club 6: 182 (1877); as *Mastigothrix aeruginea* in Wolle, *ibid.* 6: 184 (1877); as *Hypheothrix aeruginosa* in Wolle, *ibid.* 6: 282 (1879); as *Oscillaria chlorina* in Wolle, F. W. Alg. 311 (1887) in part; as *Leptothrix calcicola* in Wolle, *ibid.* 319 (1887); as *L. aeruginea* in Wolle, loc. cit. (1887); as *L. herbacea* in Wolle, *ibid.* 320 (1887); as *L. caespitosa* in Wolle, loc. cit. (1887) in part; as *Hypheothrix herbacea* in Tilden, Minn. Alg. 1: 140 (1910).

SCHIZOTHRIX LACUSTRIS A. Br. ex Gom., Ann. Sci. Nat. VII Bot. 15: 301 (1892). *Inactis lacustris* Forti, Syll. Myxophyc. 354 (1907).—Specimens seen: NEW YORK: Niagara, Aug. 1876 (D, P); Portage, Aug. 1876 (P). PENNSYLVANIA: stones, Lehigh River, Sept. 1876 (P). SOUTH CAROLINA: Northampton Swamp, *Ravenel* 14 (BM).

References: as *Leptothrix caespitosa* in Wolle, Bull. Torr. Club 6: 182 (1877), F. W. Alg. 320 (1887), in part; as *Mastigonema caespitosum* of Wolle, Bull. Torr. Club 6: 138 (1877) in part; as *M. planum* in Wolle, loc. cit. (1877) in part; as *Isactis fluviatilis* in Wolle, F. W. Alg. 244 (1887); as *I. caespitosa* in Wolle, loc. cit. (1887) in part; as *I. plana* in Tilden, Minn. Alg. 1: 281 (1910) in part.

SCHIZOTHRIX VAGINATA (Näg.) Gom., *ibid.* 15: 302 (1892). *Inactis vaginata* Næg. ex Gom. pro. synonym., loc. cit. (1892).—One collection: SOUTH CAROLINA: hillsides, Aiken, *Ravenel* 546, Dec. 1884 (PW).

HYDROCOLEUM GLUTINOSUM (Ag.) Gom., Ann. Sci. Nat. VII Bot. 15: 339 (1892).—Specimens seen: MASSACHUSETTS: Woods Hole, W. G. Farlow, Aug. 1875 (P). NEW JERSEY: Passaic River, Belleville, *Hitchcock*, July 1881 (U).

References: as *Lyngbya majuscula* in Wolle, F. W. Alg. 297 (1887), Britton Final Rep. Geol. N. J. 2: 607 (1889).

MICROCOLEUS CHTHONOPLASTES (Fl. Dan.) Thur. ex Gom., *ibid.* 15: 353 (1892).—One specimen, apparently not mentioned by Wolle: NEW JERSEY: submarine soil, with *Lyngbya aestuarii* (U).

MICROCOLEUS ACUTISSIMUS Gardn., Mem. New York Bot. Gard. 7: 55 (1927); Drouet, Amer. Journ. Bot. 24: 603 (1937). *M. pur-*

*pureus* Gardn., *ibid.* 56 (1927). *Oscillatoria claricentrosa* Gardn.,<sup>1</sup> *ibid.* 37 (1927).—One specimen: FLORIDA: with *Scytonema crustaceum*, Smith, Mar. 1878 (P).

MICROCOLEUS LACUSTRIS Farl. ex Gom., *ibid.* 15: 359 (1892).—This and several other species of filamentous Myxophyceae are contained in the material labeled by Wolle 'Phormidium congestum': see under *Cylindrospermum majus* of this paper. Specimens seen: MASSACHUSETTS: Boston, W. G. Farlow, Dec. 1876 (P). NEW YORK: sandy deposit, Aug. 1876 (C). SOUTH CAROLINA: on the ground, Aiken, Ravenel 237 (P).

References: as *Phormidium congestum* in Wolle, Bull. Torr. Club 6: 138 (1877) in part; as *Microcoleus terrestris* in Wolle, F. W. Alg. 305 (1887) in part; as *M. lacustris* in Setchell, Erythea 7: 52 (1899), in Tilden, Minn. Alg. 1: 157 (1910); as *M. vaginatus* in Tilden, *ibid.* 156 (1910).

PLECTONEMA WOLLEI Farl. ex Gom., Ann. Sci. Nat. VII Bot. 16: 98 (1892); Farlow, Bull. Bussey Inst. 2: 77 (1877). *Lyngbya Wollei* Farl. ex Gom. pro. synon., loc. cit. (1892).—Certain authors have remarked that *Plectonema Wollei* and *Lyngbya majuscula* are difficult to distinguish from each other. In herbarium specimens and other material upon which records in recent local floras have been based, the confusion of the two species is very evident. The 'characters' of the greatest diagnostic value here are, of course, the presence of false branching of the filaments of the former species and the absence of it in the latter. My experience with *Plectonema Wollei* and other Myxophyceae with branching filaments has shown that the greatest number of branchings are to be found in the oldest parts of the plant mass, often not at all at the surface of the mass. The reason for this is obvious: the youngest parts of the filaments at the surface exist in an unbranched condition before branches are formed. *P. Wollei* and *Lyngbya majuscula*, though similar in size of trichome and filament, have many dissimilarities, in texture and thickness of the sheath, in granulation and color of the protoplasm, in nature of the walls, in shapes of cells, and in the macroscopic appearance of the masses. Such differences become instantly apparent when one compares material growing in strictly marine waters (*L. majuscula*) with that from purely fresh water (*Plectonema Wollei*). Specimens seen: MASSACHUSETTS: lapidibus adnatum (Wittr. & Nordst. Alg. exs. 279, N, PW); Woburn, W. G. Farlow, 1876 (F, P). NEW JERSEY: Swartwood Lake, Sussex County, 1879 (P); Hitchcock (U). PENN-

<sup>1</sup> The TYPE of *Oscillatoria claricentrosa* in the New York Botanical Garden, PUERTO RICO: in a ditch by road to the Playa, Fajardo, Wille 697, Jan. 1915, is similar to the type of *Microcoleus acutissimus*.

SYLVANIA: Lehigh River, Sept. 1874 (P), Aug. 1876 (P), Oct. 1878 (P); Bethlehem (B, F; Rabenh. Alg. 2440, N, T); rivers & ponds (O). FLORIDA: in running stream from spring near Gainesville, *Ravenel* 30, Dec. 1877 (F, P). OHIO: Rat Island, *B. Romig*, 1878 (P).

References: as *Lyngbya Wollei* in Wolle, Rabenh. Alg. 2440 (1876), F. W. Alg. 297 (1887), Britton Final Rep. Geol. N. J. 2: 608 (1889); as *Plectonema Wollei* in Wolle, Bull. Torr. Club 6: 139 (1877), Wittr. & Nordst. Alg. exs. 6: 279 (1879), in Tilden, Minn. Alg. 1: 208 (1910).

PLECTONEMA TOMASINIANUM (Kütz.) Born. ex Gom., *ibid.* 16: 99 (1892). *Lyngbya subconfervoides* Borge, Ark. f. Bot. 15 (13): 91 (1919).—Specimens seen: NEW JERSEY: pond, July 1879 (P). PENNSYLVANIA: Krause Spring, Oct. 1878 (P), Oct. 1875 (F); calcareous springs (O, P); limestone spring, Feb. 1877 (F, O); Heyrich Spring, July 1876 (P), 1880 (N); in aqua stagnante prope Bethlehem, Apr. 1879 (Wittr. & Nordst. Alg. exs. 391, N, PW); Bethlehem, in Quellen auf Holz und Wassergewächsen (Rabenh. Alg. 2493, N); Derry Church, Dauphin County, Oct. 1887 (PW); stagnant waters (D, N, P).

References: as *Plectonema mirabile* in Wolle, Rabenh. Alg. 2493 (1877), Bull. Torr. Club 6: 139 (1877), Wittr. & Nordst. Alg. exs. 8: 391 (1880), F. W. Alg. 266 (1887) in part; as *Tolypothrix muscicola* in Wolle, Bull. Torr. Club 6: 139 (1877), F. W. Alg. 264 (1887) in part; as *Oscillaria Froelichii* var. *phormidioides* in Wolle, Bull. Torr. Club 7: 43 (1880); as *O. Froelichii* in Wolle, F. W. Alg. 315 (1887), Britton Final Rep. Geol. N. J. 2: 609 (1889) in part; as *Plectonema Tomasinianum* in Tilden, Minn. Alg. 1: 207 (1910).

PLECTONEMA NOSTOCORUM Born. ex Gom., *ibid.* 16: 102 (1892).—Specimens seen: PENNSYLVANIA: greenhouse bank (P); June 1876 (F, P). MINNESOTA: on stones, Lake Harriet, *E. Butler*, Nov. 1883 (PW). MONTANA: F. W. *Anderson*, 1886 (PW).

References: as *Oscillaria tenerrima* in Wolle, F. W. Alg. 309 (1887) in part; as *O. gracillima* in Wolle, *ibid.* 311 (1887) in part; as *Leptothrix rigidula* in Wolle, *ibid.* 321 (1887) in part; as *Oscillatoria amphibia* in Tilden, Minn. Alg. 1: 73 (1910) in part.

SYMPLOCA MURALIS Kütz. ex Gom., Ann. Sci. Nat. VII Bot. 16: 112 (1892). *S. muralis* var. *minor* Gardn.,<sup>1</sup> Univ. Calif. Publ. Bot. 14: 6 (1927).—Specimens seen: MASSACHUSETTS: Woods Hole, *W. G. Farlow* (P). SOUTH CAROLINA: Aiken, *Ravenel*, 1877 (P, T), 469, Oct.

<sup>1</sup> This 'variety' does not, in my estimation, deserve a name. In the ten specimens cited by Gardner in the Farlow Herbarium with his original description, it is true that many of the trichomes measure as little as 3  $\mu$  in diameter; nevertheless, many very closely approach 4  $\mu$ . Otherwise the masses are quite similar to those of specimens of *S. muralis* cited by Gomont. The TYPE, in the Farlow Herbarium, is: CHINA: Kushan, near Foochow, Fukien Province, *H. H. Chung* A391.

1883 (F, PW), 488, Nov. 1883 (PW), 56, 92 (F), on the ground, 378, Dec. 1880 (F); Charleston, Ravenel 335 (F). GEORGIA: brick walls, Savannah, Ravenel 4 (F).

References: as *Phormidium inundatum* in Wolle, Bull. Torr. Club 9: 25 (1882); as *Lyngbya Retzii* in Wolle, F. W. Alg. 302 (1887) in part; as *L. inundata* in Wolle, ibid. 303 (1887); as *Oscillaria aniliaria* in Wolle, ibid. 310 (1887) in part; as *Phormidium Retzii* in Tilden, Minn. Alg. 1: 102 (1910) in part.

SYMPLOCA MUSCORUM (Ag.) Gom., ibid. 16: 110 (1892). *Phormidium Corium* var. *capitatum* Gardn., Univ. Calif. Publ. Bot. 14: 4 (1927). *P. interruptum* var. *capitatum* Gardn., Mem. New York Bot. Gard. 7: 44 (1927).—Specimens seen: MARYLAND: Spesutie Island, Harford County, Smith, Oct. 1878 (P); Falls of Deep Creek, Garrett County, Smith, July 1878 (U). SOUTH CAROLINA: Langley Mills, Aiken, Ravenel 486, Nov. 1883 (PW). FLORIDA: Smith, 1877 (P, U).

References: as *Lyngbya vulgaris* in Wolle, F. W. Alg. 300 (1887) in part; as *L. interrupta* in Wolle, ibid. 302 (1887) in part; as *Symploca Muscorum* in Drouet, Field Mus. Nat. Hist. Bot. Ser. 20: 9 (1939).

LYNGBYA AESTUARII (Mert.) Liebm. ex Gom., Ann. Sci. Nat. VII Bot. 16: 127 (1892). *L. aestuarii* f. *aeruginosa* Gom., ibid. 16: 130 (1892).—Specimens seen: MASSACHUSETTS: Woods Hole, W. G. Farlow, 1876 (PW). NEW JERSEY: pools and wet ground, Perth Amboy, July 1878 (N, P); submarine soil (U); Dennisville, Cape May County (D, P); ad terram in fossis submarinis, Aug. 1878 (Wittr. & Nordst., Alg. exs. 282, N, PW); salt marshes (O).

References: as *L. aeruginosa* in Wolle, Bull. Torr. Club 6: 283 (1879); as *L. aestuarii* f. *aeruginosa* in Wolle, Wittr. & Nordst. Alg. exs. 6: 282 (1879); as *L. aestuarii* in Wolle, Bull. Torr. Club 8: 38 (1881), F. W. Alg. 296 (1887), Britton Final Rep. Geol. N. J. 2: 608 (1889), in Tilden, Minn. Alg. 1: 120 (1910); as *L. obscura* in Wolle, F. W. Alg. 298 (1887), Britton Final Rep. Geol. N. J. 2: 608 (1889), in part.

LYNGBYA MAJUSCULA (Dillw.) Harv. ex Gom., ibid. 16: 131 (1892).—One specimen: MASSACHUSETTS: Woods Hole, W. G. Farlow, 1874 (PW).

LYNGBYA SEMIPLANA (Ag.) J. Ag. ex Gom., ibid. 16: 138 (1892). *Calothrix Donnellii* (Wolle) Forti, Syll. Myxophyc. 629 (1907). *Mastigonema Donnellii* Wolle ex Forti pro. synon., loc. cit. (1907); Wolle, Bull. Torr. Club 6: 283 (1879).—One collection, FLORIDA: Smith, Mar. 1878 (TYPE of *Calothrix Donnellii*, P; isotype, D).

Reference: as *Calothrix Donnellii* in Tilden, Minn. Alg. 1: 271 (1910).

LYNGBYA PUTEALIS Mont. ex Gom., ibid. 16: 143 (1892).—Material seen: GEORGIA: ditches, Darien, Ravenel 446, Nov. 1881 (F).

FLORIDA: *Smith*, 1878 (P). ARIZONA: Tucson, *C. G. Pringle*, Apr. 1881 (F).

References: as *Phormidium subtorulosum* in Wolle, Bull. Torr. Club 6: 283 (1879); as *P. tinctorium* in Wolle, *ibid.* 9: 25 (1882), in Tilden, Minn. Alg. 1: 94 (1910); as *Lyngbya Phormidium* in Wolle, F. W. Alg. 299 (1887) in part; as *L. subtorulosa* in Wolle, *ibid.* 300 (1887); as *L. tinctoria* in Wolle, *ibid.* 301 (1887); as *Microcoleus subtorulosus* in Tilden, *ibid.* 158 (1910).

LYNGBYA VERSICOLOR (Wartm.) Gom., *ibid.* 16: 147 (1892). *Hypheothrix tenax* Wolle ex Forti, Syll. Myxophyc. 329 (1907); Wolle, Bull. Torr. Club 6: 282 (1879). *Leptothrix tenax* Wolle, F. W. Alg. 319 (1887).—Specimens seen: PENNSYLVANIA: State Quarries, Aug. 1878 (TYPE of *Hypheothrix tenax*, P; isotypes, D, U); pools (O); 'Hypheothrix tenax' (Mi); 'Oscillaria chlorina' (P); Bushkill above Nazareth (N); Bethlehem (B). OHIO: Painesville, *Beardslee*, 1878 (O, P).

References: as *Oscillaria chlorina* in Wolle, F. W. Alg. 311 (1887) in part, in Tilden, Minn. Alg. 1: 75 (1910) in part; as *Lyngbya obscura* in Wolle, *ibid.* 298 (1887) in part; as *Hypheothrix tenax* in Tilden, *ibid.* 141 (1910).

LYNGBYA OCHRACEA (Kütz.) Thur. ex Gom., *ibid.* 16: 149 (1892).—Specimens seen: MASSACHUSETTS: waterworks, Boston, *W. G. Farlow*, July 1877 (P). NEW JERSEY or PENNSYLVANIA: small pools (D, P); Apr. 1877 (F); Pennsylvania? (Wittr. & Nordst. Alg. exs. 1169, N).

References: as *Leptothrix ochracea* in Wolle, Bull. Torr. Club 6: 182 (1877), F. W. Alg. 322 (1887), Britton Final Rep. Geol. N. J. 2: 610 (1889); as *Lyngbya ochracea* in Wolle, Wittr. & Nordst. Alg. exs. 24: 1169 (1893), in Tilden, Minn. Alg. 1: 113 (1910).

PHORMIDIUM LURIDUM (Kütz.) Gom., Ann. Sci. Nat. VII Bot. 16: 165 (1892).—Specimens seen: PENNSYLVANIA: aquarium (D, F, P).

References: as *Leptothrix rigidula* in Wolle, Bull. Torr. Club 6: 182 (1877), F. W. Alg. 321 (1887) in part.

PHORMIDIUM TRELEASEI Gom., Bull. Soc. Bot. France 46: 37 (1899).—One collection from the type locality of the species, annotated by Wolle as *Leptothrix aeruginea*: ARKANSAS: Hot Springs, *H. D. Mitchell*, Feb. 1888 (N), *comm. L. M. Underwood* (PW).

PHORMIDIUM VALDERIANUM Gom., Ann. Sci. Nat. VII Bot. 16: 167 (1892).—One specimen seen: PENNSYLVANIA: 'Phormidium obscurum' (P).

Reference: as *Lyngbya obscura* in Wolle, F. W. Alg. 298 (1887) in part.

PHORMIDIUM TENUE (Menegh.) Gom., *ibid.* 16: 169 (1892).—Specimens seen: PENNSYLVANIA: '*Oscillaria amphibia*' (D, P). SOUTH CAROLINA: spring, Aiken, *Ravenel 497*, Nov. 1883 (PW).

Reference: as *Oscillaria amphibia* in Wolle, F. W. Alg. 310 (1887) in part.

PHORMIDIUM WEISSII Drouet, Field Mus. Nat. Hist. Bot. Ser. 20: 10 (1939).—One collection, bearing the annotation 'P. Boryanum', the *Phormidium* sp. referred to in Bull. Torr. Club 6: 283 (1879) as found in company with *Capsosira Brebissonii*: FLORIDA: *Smith*, Mar. 1878 (P, U).

PHORMIDIUM CORIUM (Ag.) Gom., *ibid.* 16: 172 (1892).—One specimen: PENNSYLVANIA: Mar. 1877 (F).

References: as *Oscillaria gracillima* in Wolle, Bull. Torr. Club 6: 138 (1877), F. W. Alg. 311 (1887) in part.

PHORMIDIUM INUNDATUM Kütz. ex Gom., *ibid.* 16: 172 (1892). *P. purpurascens* var. *elegans* Drouet, Bot. Gaz. 95: 696 (1934).—Specimens seen: PENNSYLVANIA: with *P. uncinatum*, waterfalls (O, P, U), Apr. 1877 (N, P); '*Oscillaria antliaria*' (D, N, P). MARYLAND: Baltimore County, *Smith*, May 1878 (U). SOUTH CAROLINA: Langley Mills, Aiken, *Ravenel 485*, Nov. 1883 (PW).

References: as *Oscillaria gracillima* in Wolle, Bull. Torr. Club 6: 138 (1877), F. W. Alg. 311 (1887) in part; as *Phormidium cataractum* in Wolle, Bull. Torr. Club 6: 183 (1877) in part; as *P. fonticola* in Wolle, *ibid.* 6: 283 (1879); as *Lyngbya cataracta* in Wolle, F. W. Alg. 302 (1887) in part; as *Oscillaria antliaria* in Wolle, *ibid.* 310 (1887) in part; as *Phormidium inundatum* in Setchell, Erythea 7: 53 (1899), in Tilden, Minn. Alg. 1: 100 in part (1910), in Drouet, Field Mus. Nat. Hist. Bot. Ser. 20: 11 (1939); as *P. incrustatum* var. *catractarum* in Tilden, *ibid.* 100 (1910) in part.

PHORMIDIUM PAPYRACEUM (Ag.) Gom., *ibid.* 16: 173 (1892). *P. autumnale* var. *minus* Gardn.,<sup>1</sup> Mem. New York Bot. Gard. 7: 45 (1927).—Specimens seen: PENNSYLVANIA: from aquarium (P). VIRGINIA: Prince Edward County, *Smith*, Apr. 1878 (P, U).

PHORMIDIUM RETZII (Ag.) Gom., *ibid.* 16: 175 (1892). *P. leptodermum* var. *capitatum* Gardn., Mem. New York Bot. Gard. 7: 43 (1927).—Specimens seen: CONNECTICUT: on stones in Shetucket River, Lisbon, W. A. Setchell, Aug. 1885 (P). VIRGINIA: Prince Edward County, *Smith*, Apr. 1878 (P, U). SOUTH CAROLINA: *Smith*, Apr. 1878 (P, U); stream, Langley Mills, Aiken, *Ravenel 486*, Nov. 1883 (BM). MICHIGAN: Detroit, D. H. Campbell, 1883 (PW).

References: as *Oscillaria percursa* in Wolle, Bull. Torr. Club 6: 282 (1879), F. W. Alg. 315 (1887), in part; as *Lyngbya papyrina* in Wolle, Bull. Torr. Club

<sup>1</sup> The TYPE of *P. autumnale* var. *minus* in the New York Botanical Garden, PUERTO RICO: in reservoir west of Experiment Station, Rio Piedras, N. Wille 203, consists of well preserved *P. papyraceum*.



12: 129 (1865), F. W. Alg. 302 (1887); as *L. Phormidium* in Wolle, *ibid.* 299 (1887, in part; as *L. vulgaris* in Wolle, *ibid.* 300 (1887) in part; as *L. rupestris* in Wolle, *loc. cit.* (1887) in part; as *Phormidium Retzii* in Tilden, *Minn. Alg.* 1: 102 (1910) in part; as *P. Retzii f. rupestris* in Tilden, *ibid.* 103 (1910) in part; as *Symploca Muscorum* in Tilden, *ibid.* 132 (1910) in part.

PHORMIDIUM SUBMEMBRANEUM (Ard. & Straff.) Gom., *Ann. Sci. Nat. VII Bot.* 16: 180 (1892).—I have discussed the North American distribution of this species in *Rhodora* 40: 262–263 (1938). One specimen, Farlow's *Oscillaria subtorulosa*: MAINE: Eastport, W. G. Farlow (P).

PHORMIDIUM FAVOSUM (Bory) Gom., *ibid.* 16: 180 (1892).—Specimens seen: MASSACHUSETTS: Bussey Brook, Boston (P). PENNSYLVANIA: 1875 (F); 1879 (D, P). MARYLAND: foul drain ditch, Baltimore County, *Smith*, May 1878 (P, U).

References: as *Oscillaria tenuis* in Wolle, F. W. Alg. 313 (1887) in part; as *O. limosa* in Wolle, *ibid.* 313 (1887) in part; as *O. nigra* in Wolle, *ibid.* 315 (1887) in part; as *Phormidium favosum* in Drouet, *Field Mus. Nat. Hist. Bot. Ser.* 20: 11 (1939).

PHORMIDIUM SUBFUSCUM var. JOANNIANUM (Kütz.) Gom., *ibid.* 16: 184 (1892).—Specimens seen: PENNSYLVANIA: insides of wooden sluice (U); pools (U); 'P. leptodermum' (N, P); 'Oscillaria tenuis var. fallax' (P). MARYLAND: mill dam, Baltimore County, *Smith*, May 1878 (P, U).

References: as *Lyngbya cataracta* in Wolle, F. W. Alg. 302 (1887) in part; as *Oscillaria tenuis* in Wolle, *ibid.* 313 (1887) in part; as *Phormidium subfuscum* var. *Joannianum* in Drouet, *Field Mus. Nat. Hist. Bot. Ser.* 20: 11 (1939).

PHORMIDIUM UNCINATUM (Ag.) Gom., *ibid.* 16: 184 (1892).—Specimens seen: NEW YORK: roadside ditch, Ithaca, *Hitchcock*, Aug. 1879 (U). PENNSYLVANIA: waterfalls (P); with *P. inrundatum*, 'Oscillaria antliaria' (D, P); mill dam (N). MARYLAND: foul drain ditch, Baltimore County, *Smith*, May 1878 (P). OHIO: 'O. fontana' (P); Painesville, *H. C. Beardslee* (O).

References: as *Phormidium cataractum* in Wolle, *Bull. Torr. Club* 6: 183 (1877) in part; as *Lyngbya cataracta* in Wolle, F. W. Alg. 302 (1887) in part; as *Oscillaria antliaria* in Wolle, *ibid.* 310 (1887) in part; as *O. tenuis* in Wolle, *ibid.* 313 (1887) in part; as *O. limosa* in Wolle, *loc. cit.* (1887) in part; as *Phormidium uncinatum* in Drouet, *Field Mus. Nat. Hist. Bot. Ser.* 20: 11 (1939).

PHORMIDIUM AUTUMNALE (Ag.) Gom., *ibid.* 16: 187 (1892). *Lyngbya hahatonkensis* Drouet, *Bot. Gaz.* 95: 698 (1934).—Specimens seen: PENNSYLVANIA: greenhouse (D, P), Dec. 1876 (P), July 1877 (P); wood in tank (N); 'Oscillaria subfusca' (P); 'O. tenuis var. fallax' (P). TEXAS: on surface of damp earth, *Ravenel* (P).

References: as *Oscillaria violacea* in Wolle, *Bull. Torr. Club* 6: 182 (1877), F. W. Alg. 311 (1887); as *Phormidium vulgare* var. *publicum* in Wolle, *Bull. Torr. Club* 6:

183 (1877); as *Oscillaria subfusca* in Wolle, *ibid.* 7: 43 (1880), F. W. Alg. 312 (1887); as *Lyngbya vulgaris* in Wolle, *ibid.* 300 (1887) in part; as *Oscillaria tenuis* in Wolle, *ibid.* 313 (1887) in part; as *O. aerugineo-caerulea* in Wolle, *ibid.* 311 (1887) in major part; as *Phormidium autumnale* in Setchell, *Erythea* 7: 53 (1899), in Tilden, *Minn. Alg.* 1: 107 in part (1910); as *Oscillatoria violacea* in Tilden, *ibid.* 79 (1910),

OSCILLATORIA PRINCEPS Vauch. ex Gom., *Ann. Sci. Nat.* VII Bot. 16: 206 (1892). *O. obtusa* Gardn., *Mem. New York Bot. Gard.* 7: 38 (1927). *Lyngbya gigantea* Lewis, Zirk. & Patr., *Journ. Elisha Mitch. Sci. Soc.* 1933: 221 (1933).—Specimens seen: NEW JERSEY: *Hitchcock* (U). PENNSYLVANIA: Rockdale, 1878 (P); '*O. imperator*' (Mi); in stagnis pr. Bethlehem, Aug. 1877 (Rabenh. Alg. 2535, N, T), Aug. 1879 (Wittr. & Nordst. Alg. exs. 393a, N, PW, U); small pools (O, U); Bethlehem (B); 1879 (P); Tobyhanna, Aug. 1878 (D, N, P); stagnant waters (O). FLORIDA: *Smith*, Feb. 1878 (U), Mar. 1878 (P, U). TERRITORY OF HAWAII: *Hitchcock* (PW).

References: as *Oscillaria imperator* in Wolle, Rabenh. Alg. 2535 in part (1878), F. W. Alg. 317 in part (1887); as *O. princeps* in Wolle, *Bull. Torr. Club* 6: 282 (1879), Wittr. & Nordst. Alg. exs. 8: 393a (1880), F. W. Alg. 317 (1887); as *O. percursa* in Wolle, *ibid.* 315 (1887) in part; as *Oscillatoria princeps* in Tilden, *Minn. Alg.* 1: 62 (1910) in part.

OSCILLATORIA PROBOSCIDEA Gom., *ibid.* 16: 209 (1892). *O. refringens* Gardn., *Mem. New York Bot. Gard.* 7: 38 (1927).—One collection, PENNSYLVANIA: in stagnis pr. Bethlehem, Aug. 1877, with *O. princeps* (Rabenh. Alg. 2535, N. T).

References: as *Oscillaria imperator* in Wolle, Rabenh. Alg. 2535 (1878), F. W. Alg. 317 (1887), in part.

OSCILLATORIA SANCTA var. CALDARIORUM Gom., *ibid.* 16: 210 (1892).—Specimens seen: NEW JERSEY: Lackawanna Springs, 1879 (P). PENNSYLVANIA: in stagnant waters (P).

References: as *Oscillaria Froelichii* in Wolle, F. W. Alg. 315 (1887), Britton *Final Rep. Geol. N. J.* 2: 609 (1889), in part.

OSCILLATORIA SANCTA var. AEQUINOCTIALIS Gom., *loc. cit.* (1892).—Specimens seen: NEW YORK: Buffalo, Aug. 1876 (P). NEW JERSEY: Chapman, Nov. 1875 (P).

References: as *Oscillaria major* in Wolle, *Bull. Torr. Club* 6: 138 (1877), F. W. Alg. 316 (1887), Britton *Final Rep. Geol. N. J.* 2: 609 (1889), in part; as *O. Froelichii* in Wolle, F. W. Alg. 315 (1887), Britton *Final Rep. Geol. N. J.* 2: 609 (1889), in part; as *Oscillatoria major* in Tilden, *Minn. Alg.* 1: 67 (1910) in part.

OSCILLATORIA LIMOSA Ag. ex Gom., *ibid.* 16: 210 (1892).—Specimens seen: VERMONT: small brooks, Bristol, C. G. Pringle (N). PENNSYLVANIA: '*Phormidium* (Lyngbya) *obscurum*' (O); '*Oscillaria Froelichii*' (Mi); Bushkill, Sept. 1878 (P); grown on card, Apr. 1877

(D, F, P), Apr. 1879 (F, U); shallow pools (N, U), waters (U); 1880 (N, O); stagnant waters (O); slow waters, May 1877 (N); Pennsylvania (N). MARYLAND: Garrett County, *Smith*, Aug. 1878 (U).

References: as *Lyngbya obscura* in Wolle, F. W. Alg. 298 (1887) in part; as *L. Phormidium* in Wolle, *ibid.* 299 (1887) in part; as *Oscillaria limosa* in Wolle, *ibid.* 313 (1887) in part; as *O. Froelichii* in Wolle, *ibid.* 315 (1887) in part; as *O. major* in Wolle, *ibid.* 316 (1887) in part; as *Oscillatoria limosa* in Setchell, *Erythea* 7: 53 (1899), in Tilden, *Minn. Alg.* 1: 65 in part (1910), in Drouet, *Field Mus. Nat. Hist. Bot. Ser.* 20: 12 (1939); as *O. major* in Tilden, *ibid.* 67 (1910) in part.

OSCILLATORIA CURVICEPS Ag. ex Gom., *ibid.* 16: 213 (1892).—Specimens seen: PENNSYLVANIA: 'Oscillaria Froelichii' (N, P); stagnant waters, Apr. 1877 (N, U).

Reference: *Oscillaria Froelichii* in Wolle, F. W. Alg. 315 (1887) in part.

OSCILLATORIA ORNATA Kütz. ex Gom., *ibid.* 16: 214 (1892).—One specimen: MASSACHUSETTS: Jamaica Plain, *W. G. Farlow* (P).

Reference: as *Oscillaria tenuis* in Wolle, F. W. Alg. 313 (1887) in part.

OSCILLATORIA MARGARITIFERA Kütz. ex Gom., *Ann. Sci. Nat.* VII Bot. 16: 216 (1892).—Specimens seen: NEW JERSEY: Port Morris, *Hitchcock*, May 1879 (U); with *Lyngbya aestuarii*, Dennisville, Cape May County (D, P).

References: as *Oscillaria Grateloupri* in Wolle, *Bull. Torr. Club* 7: 43 (1880), *F. W. Alg.* 316 (1887).

OSCILLATORIA CORALLINAE (Kütz.) Gom., *ibid.* 16: 218 (1892).—One specimen, FLORIDA: *Smith*, 1878 (P).

Reference: as *Oscillaria anguina* in Wolle, F. W. Alg. 314 (1887).

OSCILLATORIA TENUIS Ag. ex Gom., *ibid.* 16: 220 (1892). *O. tenuis* var. *levis* Gardn., *Mem. New York Bot. Gard.* 7: 35 (1927).—The Colorado material which Wolle labeled '*Lyngbya cincinnata*' consists almost entirely of *Oscillatoria tenuis*. What he meant by "Diam. of trichomes, with sheaths, 25–30  $\mu$ " I cannot guess. Other material annotated as '*Lyngbya cincinnata*' is referred in this paper to *Scytonema cincinnatum*. Specimens seen: MASSACHUSETTS: Fall River (P). PENNSYLVANIA: hot (warm) water (O, U), 1878 (D, P), 1880 (N), rolling mill (N), near Bethlehem (N); in heissem Wasser an Dampfmühlen (Rabenh. Alg. 2536, N); '*Oscillaria neglecta*' (P); '*O. nigra*' (N); Bethlehem (B). MARYLAND: Garrett County, *Smith*, July 1878 (U); Anne Arundel County, *Smith*, May 1878 (P); foul drain ditch, Baltimore County, *Smith*, May 1878 (P, U). FLORIDA: Race Creek, Polk County, *Smith*, Mar. 1880 (U); Fort Meade, *Smith* (U). OHIO: Painesville, *H. C. Beardslee* (O). COLORADO:

'*Lyngbya cincinnata*' (P). CALIFORNIA: Santa Cruz, *C. L. Anderson* (N).

References: as *Oscillaria Cortiana* in Wolle, Bull. Torr. Club 6: 182 (1877), Rabenh. Alg. 2536 (1878), F. W. Alg. 313 (1887); as *Lyngbya cincinnata* in Wolle, Bull. Torr. Club 6: 183 (1877), F. W. Alg. 296 in part (1887); as *Oscillaria chalybea* in Wolle, Bull. Torr. Club 6: 282 (1879); as *O. limosa* in Wolle, F. W. Alg. 313 (1887) in part; as *O. tenuis* in Wolle, loc. cit. (1887) in part; as *O. nigra* in Wolle, ibid. 315 (1887) in part; as *O. Froelichii* var. *neglecta* in Wolle, ibid. 316 (1887) in part; as *Oscillatoria limosa* in Tilden, Minn. Alg. 1: 65 (1910); as *O. tenuis* in Tilden, ibid. 71 in part (1910), in Drouet, Rhodora 40: 268 (1938), Field Mus. Nat. Hist. Bot. Ser. 20: 12 (1939); as *O. Cortiana* in Tilden, ibid. 81 (1910).

OSCILLATORIA AMPHIBIA Ag. ex Gom., ibid. 16: 221 (1892).—One collection: NEW JERSEY: with *O. salinarum*, docks, Jersey City Waterworks, Belleville, *Hitchcock*, July 1881 (U).

Reference: as *Oscillaria subtilissima* in Wolle, F. W. Alg. 309 (1887).

OSCILLATORIA SPLENDIDA Grev. ex Gom., Ann. Sci. Nat. VII Bot. 16: 224 (1892).—Specimens seen: NEW YORK: Lorillard's Estate Pond, Bronx Park, New York, *Hitchcock*, Sept. 1879 (U). PENNSYLVANIA: aquarium (N, P); with *Oscillatoria tenuis* (P); sluggish water (P); Lehigh, Aug. 1878 (N); spring waters (U); quiet waters (O). MICHIGAN: Detroit, *D. H. Campbell*, 1883 (PW).

References: as *Oscillaria elegans* in Wolle, Bull. Torr. Club 6: 183 (1877), F. W. Alg. 310 (1887); as *O. gracillima* in Wolle, ibid. 311 (1887) in part; as *O. Froelichii* var. *neglecta* in Wolle, ibid. 315 (1887) in part; as *Oscillatoria splendida* in Tilden, Minn. Alg. 1: 77 (1910) in part; as *Phormidium laminosum* in Tilden, ibid. 96 (1910) in part.

OSCILLATORIA ANIMALIS Ag. ex Gom., ibid. 16: 227 (1892).—One specimen: SOUTH CAROLINA: from sides of a wooden trough into which the warm water from artesian well flows, Charleston, *Ravenel* 328, July 1879 (F).

OSCILLATORIA SALINARUM Collins, Phyc. Bor.-Amer. 24: 1160 (1904); Drouet, Field Mus. Nat. Hist. Bot. Ser. 20: 13 (1939). *O. luteola* Drouet, Rhodora 39: 277 (1937).—One specimen seen: NEW JERSEY: docks, Jersey City Waterworks, Belleville, *Hitchcock*, July 1881 (U).

References: as *Oscillaria tenuis* in Wolle, F. W. Alg. 313 (1887) in part, Britton Final Rep. Geol. N. J. 2: 609 (1889).

OSCILLATORIA FORMOSA Bory ex Gom., ibid. 16: 230 (1892).—One specimen: IOWA: Iowa City, July 1878 (P).

References: as *Oscillaria limosa* in Wolle, F. W. Alg. 313 (1887) in part; as *O. nigra* in Wolle, ibid. 315 (1887) in part.

OSCILLATORIA BREVIS Kütz. ex Gom., *ibid.* 16: 229 (1892).—One specimen: PENNSYLVANIA: ditches, wet ground (U).

Reference: as *Oscillaria limosa* in Wolle, F. W. Alg. 313 (1887) in part.

OSCILLATORIA CHALYBEA Mert. ex Gom., *ibid.* 16: 232 (1892).—One specimen, FLORIDA: *Smith*, 1878 (P).

References: as *Oscillaria rufa* in Wolle, Bull. Torr. Club 6: 282 (1879); *O. limosa* in Wolle, F. W. Alg. 315 (1887) in part.

OSCILLATORIA ARTICULATA Gardn., Mem. New York Bot. Gard. 7: 34 (1927). *O. articulata* var. *circinata* Gardn., *ibid.* 7: 35 (1927). *O. Grunowiana* var. *articulata* Drouet, Amer. Journ. Bot. 24: 608 (1937).—One collection, NEW YORK: inundated soil, Buffalo, Aug. 1877 (F, N, O, P).

References: as *Oscillaria brevis* in Wolle, F. W. Alg. 312 (1887); as *Oscillatoria brevis* in Tilden, Minn. Alg. 1: 79 (1910) in part.

SPIRULINA SUBSALSA Oerst. ex Gom., Ann. Sci. Nat. VII Bot. 16: 253 (1892). *Arthrospira subsalsa* Crow apud Croasdale, F. W. Alg. Woods Hole, Mass. 18 (1935).—Specimens seen: MAINE: with *Phormidium submembranaceum*, Eastport, W. G. Farlow (P). FLORIDA: 'Beggiatoa' (P).

### Excludenda

BEGGIATO A HINNULEA Wolle, Bull. Torr. Club 6: 182 (1877). *Leptothrix hinnulea* Wolle, F. W. Alg. 320 (1887). *Lyngbya hinnulea* Tilden, Minn. Bot. Stud. 1: 235 (1895). *Hypheothrix? hinnulea* Forti, Syll. Myxophyc. 336 (1907).—Wolle's original material and the Minnesota specimens distributed by Tilden in Amer. Alg. 1: 69 (1894) (FM, N, U) are truly bacterial and should find a proper place in a species of *Cladothrix* or related genus. One collection: PENNSYLVANIA: trenches, warm water (TYPE of *Beggiatoa hinnulea*, P).

Reference: as *Hypheothrix? hinnulea* in Tilden, Minn. Alg. 1: 140 (1910).

INACTIS AUSTINII Wolle ex Forti, Syll. Myxophyc. 351 (1907); Wolle, Bull. Torr. Club 6: 183 (1877).—The specimen labeled thus consists entirely of a lichen: NEW JERSEY: Little Falls, Passaic County (TYPE of *I. Austinii*, P).

Reference: as *I. Austinii* in Tilden, Minn. Alg. 1: 149 (1910).

LYNGBYA PHORMIDIUM var. RIVULARIS Wolle ex Forti, Syll. Myxophyc. 304 (1907); Wolle, F. W. Alg. 299 (1887). *Symploca Muscorum* var. *rivularis* Tilden ex Forti, loc. cit. (1907), as to name-bearing synonym, not as to specimens.—The specimens cited here appear to be those indicated in Wolle's description. The filaments are very poorly preserved, so that it is doubtful to just what genus

of Myxophyceae the material should be referred. Specimens distributed by Tilden in Amer. Alg. No. 67 (FM, N, U) as *S. Muscorum* var. *rivularis*, contain plants of a very different type. Material seen: PENNSYLVANIA: attached to stones in Lehigh River, 1878 (TYPE of *Lyngbya Phormidium* var. *rivularis*, P), 15 July 1879 (F, N, P).

References: as *Symploca Muscorum* var. *rivularis* in Tilden, Amer. Alg. 1: 67 (1894), Minn. Bot. Stud. 1 (1): 235 (1894), Minn. Alg. 1: 133 (1910), in Geitler, Rabenh. Krypt.-Fl. 14: 1123 (1932).

Certain specimens, the bases of reports of species of filamentous Myxophyceae in the literature, prove to be material of other groups of algae or of Myxophyceae in an unrecognizable condition. The one meager collection, FLORIDA: *Smith*, Mar. 1878 (P, U), upon which the reports of *Capsosira Brebissonii* in Wolle, Bull. Torr. Club 6: 283 (1879) and in Tilden, Minn. Alg. 1: 251 (1910) are founded contains masses of *Entophysalis?* sp. The specimen, PENNSYLVANIA: old wooden tanks (P), referred to by Wolle, F. W. Alg. 289 (1887) as *Sphaerozyga polysperma* consists of a gelatinous matrix in which small desmids (*Cylindrocystis?* sp.) are imbedded. The specimens referred to as *Phormidium julianum* in Wolle, Bull. Torr. Club 6: 283 (1879), as *Lyngbya juliana* in Wolle, F. W. Alg. 301 (1887), and as *L. lutea* in Tilden, *ibid.* 114 in part (1910), FLORIDA: *Smith*, Mar. 1878 (P, U), are of filamentous Myxophyceae in an unrecognizable state.

### Inquirenda

Legitimate names based upon specimens of the Wolle herbarium which as yet I have been unable to find, are the following. From their published descriptions and figures, we may suppose that most of them will prove to be synonymous with species treated in this paper.

SIROSIPHON BRANDEGEEI Wolle, F. W. Alg. 274 (1887); Forti, Syll. Myxophyc. 590 (1907); Tilden, Minn. Alg. 1: 251 (1907).

ANABAENA FLOS-AQUAE var. AESTUARII Wolle ex Forti, Syll. Myxophyc. 445 (1907); Wolle, F. W. Alg. 287 (1887), Britton Final Rep. Geol. N. J. 2: 607 (1889).

NODULARIA PALUDOSA Wolle ex Forti, Syll. Myxophyc. 435 (1907); Wolle, F. W. Alg. 291 (1887); Tilden, Minn. Alg. 1: 183 (1910).

CALOTHRIX LACUCOLA Wolle, F. W. Alg. 239 (1887), Bull. Torr. Club 8: 39 (1881), Britton Final Rep. Geol. N. J. 2: 603 (1889); Forti, Syll. Myxophyc. 629 (1907); Tilden, Minn. Alg. 1: 272 (1910).

CALOTHRIX GRACILIS Wolle, F. W. Alg. 237 (1887), Bull. Torr. Club 9: 25 (1882).

ISACTIS CAESPITOSA var. TENUIOR-VIRIDIS Wolle, F. W. Alg. 245 (1887).

SCYTONEMA CORTEX f. SAXICOLA Green apud Wolle, F. W. Alg. 257 (1887).

SYMPHYOSIPHON BORNETIANUS Wolle, F. W. Alg. 261 (1887); Forti, Syll. Myxophyc. 536 (1907); Tilden, Minn. Alg. 1: 227 (1910).

TOLYPOTHRIX RAVENELII Wolle, F. W. Alg. 265 (1887), Bull. Torr. Club 6: 285 (1879); Forti, Syll. Myxophyc. 542 (1907); Tilden, Minn. Alg. 1: 234 (1910); Geitler, Rabenh. Krypt.-Fl. 14: 732 (1932); Smith, Freshw. Alg. U. S. 95 (1933).

HYPHEOTHRIX BULLOSA Wolle ex Forti, Syll. Myxophyc. 329 (1907); Wolle, Bull. Torr. Club 6: 182 (1877); Tilden, Minn. Alg. 1: 142 (1910). *Leptothrix bullosa* Wolle ex Forti pro. synonym., ibid. 329 (1907); Wolle, F. W. Alg. 321 (1887).

SPIRULINA DUPLEX Wolle ex Forti, Syll. Myxophyc. 216 (1907); Wolle, F. W. Alg. 323 (1887); Tilden, Minn. Alg. 1: 90 (1910); Crow, Trans. Amer. Microsc. Soc. 46: 145 (1927); Geitler, Rabenh. Krypt.-Fl. 14: 918 (1932).

Specimens referred to in the literature under the following names appear to be lacking. Many of such specimens may be already included in this treatment, but for lack of data and proper annotation they cannot be identified with the names under which they were recorded in publications. If we can judge by Wolle's notes and drawings, however, few of these recorded names refer to species not appearing in the treatment above.

*Sirosiphon crustaceus* in Wolle, F. W. Alg. 274 (1887); *S. pulvinatus* in Wolle, Britton Final Rep. Geol. N. J. 2: 605 (1889); *S. compactus* in Wolle, loc. cit. (1889); *Stigonema hormoides* var. *rhizodes* in Tilden, Minn. Alg. 1: 245 (1910); *Nostochopsis* sp. in Wolle, Bull. Torr. Club 6: 283 (1879); *Fischera thermalis* in Wolle, ibid. 6: 139 (1877); *Fischerella ambigua* in Tilden, ibid. 242 (1910); *Hapalosiphon torulosus* in Wolle, F. W. Alg. 276 (1887); *H. Brebissonii* in Wolle, Bull. Torr. Club 8: 39 (1881), F. W. Alg. 276 (1887), Britton Final Rep. Geol. N. J. 2: 606 (1889); *H. tenuissimus* in Wolle, Bull. Torr. Club 8: 39 (1881), F. W. Alg. 277 (1887), Britton Final Rep. Geol. N. J. 2: 606 (1889); *H. fontinalis* var. *tenuissimus* in Tilden, ibid. 240 (1910).

*Nostoc tenuissimum* in Wolle, F. W. Alg. 282 (1887); *N. calcicola* in Wolle, ibid. 283 (1887); *N. rupestre* in Wolle, loc. cit. (1887), Britton Final Rep. Geol. N. J. 2: 606 (1889); *N. macrosporum* in Wolle, F. W. Alg. 284 (1887), in Tilden, Minn. Alg. 1: 175 (1910); *N. comminutum*, *N. sphaericum*, *N. caeruleum*, *N. pruniforme* in

Wolle, Britton Final Rep. Geol. N. J. 2: 606 (1889); *N. sphaeroides* in Wolle, Bull. Torr. Club 6: 217 (1878); *N. microscopicum* in Tilden, ibid. 176 (1910); *Anabaena flos-aquae* in Wolle, F. W. Alg. 286 (1887), Britton Final Rep. Geol. N. J. 2: 606 (1889), in Tilden, ibid. 189 (1910); *A. gigantea* in Wolle, F. W. Alg. 287 (1887); *A. variabilis* in Wolle, loc. cit. (1887), in Tilden, ibid. 187 (1910); *A. stagnalis* in Wolle, Bull. Torr. Club 6: 183 (1877), F. W. Alg. 288 (1887); *A. oscillarioides* in Wolle, loc. cit. (1887), Britton Final Rep. Geol. N. J. 2: 607 (1889); *A. catenula* and *A. torulosa* in Tilden, ibid. 191, 192 (1910); *Sphaerozyga Hassallii* and *S. Smithii* in Wolle, F. W. Alg. 289, 290 (1887); *S. polysperma* in Wolle, Britton Final Rep. Geol. N. J. 2: 607 (1889); *S. variabilis* in Wolle, Bull. Torr. Club 6: 183 (1877); *S. Ralfsii* in Wolle, ibid. 7: 44 (1880); *Cylindrospermum comatum* in Wolle, F. W. Alg. 293 (1887), in Tilden, ibid. 198 (1910); *C. macrospermum* in Wolle, Britton Final Rep. Geol. N. J. 2: 607 (1889); *C. limicola* in Wolle, loc. cit. (1889); *C. riparium* in Wolle, Bull. Torr. Club 6: 183 (1877); *C. majus* in Setchell, Erythea 7: 51 (1899).

*Amphithrix villosa* in Wolle, Bull. Torr. Club 6: 184 (1877); *Calothrix Dillwynii* and *C. gypsophila* in Wolle, F. W. Alg. 237 (1887), Britton Final Rep. Geol. N. J. 2: 603 (1889); *C. Brebissonii* in Wolle, F. W. Alg. 238 (1887), Britton Final Rep. Geol. N. J. 2: 603 (1889); *C. Meneghiniana* in Wolle, loc. cit. (1889); *C. Orsiniana* in Wolle, F. W. Alg. 236 (1887); *C. mirabilis* in Wolle, Bull. Torr. Club 10: 20 (1883); *C. Castellii* in Tilden, Minn. Alg. 1: 271 (1910); *C. Braunii* in Setchell, Erythea 7: 46 (1899); *Mastigonema halos* and *M. sejunctum* in Wolle, F. W. Alg. 242, 243 (1887); *M. elongatum*, *M. fibrosum*, and *M. fertile* in Wolle, ibid. 243, 244 (1887), in Tilden, ibid. 271, 272 (1910); *M. luteum* 'sp. nov.' in Wolle, Bull. Torr. Club 6: 139 (1877); *Schizosiphon crustiformis* in Wolle, ibid. 6: 284 (1879); *Dichothrix gypsophila* in Tilden, ibid. 278 (1910); *Isactis caespitosa* in Wolle, Britton Final Rep. Geol. N. J. 2: 603 (1889); *I. fluviatilis* in Wolle, Bull. Torr. Club 8: 38 (1881), Britton Final Rep. Geol. N. J. 2: 603 (1889); *Zonotrichia haematites* in Wolle, Bull. Torr. Club 6: 184 (1877); *Rivularia dura* in Wolle, F. W. Alg. 249 (1887), Britton Final Rep. Geol. N. J. 2: 603 (1889), in Tilden, ibid. 291 (1910); *R. haematites* in Tilden, ibid. 290 (1910); *Gloeotrichia natans* and *G. Pisum* in Wolle, ibid. 604 (1889); *Gloeotrichia* sp. in Wolle, Bull. Torr. Club 7: 44 (1880).

*Tolypothrix distorta* in Wolle, Britton Final Rep. Geol. N. J. 2: 605 (1889); *T. pulchra* and *T. flaccida* in Wolle, F. W. Alg. 264, 266



(1887); *T. muscicola* in Wolle, Britton Final Rep. Geol. N. J. 2: 605 (1889); *T. tenuis* in Wolle, loc. cit. (1889), Bull. Torr. Club 10: 20 (1888), in Tilden, Minn. Alg. 1: 229 (1910); *T. Wartmanniana* and *T. geminata* in Wolle, ibid. 6: 185 (1877); *T. tenuis* f. *bryophila* in Wolle, F. W. Alg. 265 (1887), in Tilden, ibid. 230 (1910); *Desmonema Wrangelii* in Tilden, ibid. 235 (1910); *Symphyosiphon hirtulus*, *S. Castellii*, *S. ambiguus*, and *S. crustaceus* in Wolle, F. W. Alg. 261, 262, 263 (1887); *Scytonema Notarisii*, *S. Castellii*, and *S. dubium* in Wolle, ibid. 254, 255, 260 (1887); *S. ambiguum* in Wolle, Bull. Torr. Club 6: 284 (1879); *S. mirabile*, *S. crustaceum*, and *S. hirtulum* in Tilden, ibid. 222, 226, 228 (1910).

*Schizothrix hyalina* in Tilden, Minn. Alg. 1: 151 (1910); *Leptothrix tinctoria* and *L. laminosa* in Wolle, F. W. Alg. 321 (1887); *Hypheothrix tinctoria* in Wolle, Bull. Torr. Club 6: 282 (1879); *H. luminosa* in Wolle, ibid. 10: 21 (1883); *Hydrocoleum homoeotrichum* in Wolle, ibid. 6: 183 (1877), in Tilden, ibid. 137 (1910), in Smith, Freshw. Alg. U. S. 84 (1933); *H. helveticum* in Wolle, ibid. 6: 283 (1879); *H. lyngbyaceum* in Tilden, ibid. 135 (1910); *Microcoleus anguiformis* and *M. hyalinus* in Wolle, F. W. Alg. 306, 307 (1887), Britton Final Rep. Geol. N. J. 2: 609 (1889); *M. gracilis* in Wolle, Bull. Torr. Club 7: 44 (1880), F. W. Alg. 306 (1887); *M. lacustris* in Wolle, Bull. Torr. Club 8: 38 (1881); *M. chthonoplastes* in Tilden, ibid. 155 (1910); *Symploca terrestris* in Wolle, ibid. 6: 283 (1879); *Lyngbya vermicularis* and *L. membranacea* in Wolle, F. W. Alg. 297, 300 (1887); *L. arenaria* in Wolle, ibid. 299 (1887), Britton Final Rep. Geol. N. J. 2: 608 (1889); *L. vulgaris* and *L. cataracta* in Wolle, loc. cit. (1889); *L. major* in Wolle, Bull. Torr. Club 6: 283 (1879), in Tilden, ibid. 126 (1910); *Phormidium Retzii* and *P. Joannianum* in Wolle, loc. cit. (1879); *P. olivaceum* in Wolle, ibid. 6: 183 (1877); *P. arenarium* in Wolle, ibid. 7: 43 (1880); *P. membranaceum* in Wolle, ibid. 8: 38 (1881); *P. interruptum* in Wolle, loc. cit. (1881), in Tilden, ibid. 102 (1910); *P. tenue*, *P. subfuscum*, and *P. subfuscum* var. *Joannianum* in Tilden, ibid. 98, 105, 106 (1910); *Oscillaria detera* in Wolle, Bull. Torr. Club 9: 25 (1882), F. W. Alg. 310 (1887); *O. leptotricha* in Wolle, ibid. 6: 183 (1877), F. W. Alg. 311 (1887); *O. cruenta* in Wolle, ibid. 312 (1887); *O. natans* in Wolle, Bull. Torr. Club 7: 43 (1880), F. W. Alg. 314 (1887), Britton Final Rep. Geol. N. J. 2: 609 (1889); *O. chalybea* in Wolle, Bull. Torr. Club 12: 129 (1885), F. W. Alg. 314 (1887); *O. Bonnemaisoni* in Wolle, Bull. Torr. Club 6: 138 (1877), F. W. Alg. 316 (1887); *O. littoralis* in Wolle, Bull. Torr. Club 9: 25 (1882), F. W. Alg. 317 (1887), Britton Final Rep. Geol. N. J. 2: 609 (1889);

*O. brevis* in Wolle, Bull. Torr. Club 6: 138 (1877), Britton Final Rep. Geol. N. J. 2: 609 (1889); *O. gracillima* and *O. limosa* in Wolle, loc. cit. (1889); *O. Porettana* in Wolle, Bull. Torr. Club 7: 43 (1880); *O. subsalsa* var. *dulcis* in Wolle, loc. cit. (1880); *O. crassissima* in Wolle, ibid. 9: 25 (1882); *Oscillatoria Bonnemaisionii*, *O. tenuis* var. *natans*, *O. cruenta*, and *O. chalybea* in Tilden, ibid, 68, 72, 80, 82 (1910); *Arthrospira Jenneri* in Tilden, ibid. 85 (1910); *Spirulina Jenneri* in Wolle, Bull. Torr. Club 9: 25 (1882), F. W. Alg. 323 (1887).

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# THE PLANKTONIC FRESHWATER SPECIES OF MICROCYSTIS

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# THE PLANKTONIC FRESHWATER SPECIES OF MICROCYSTIS

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Species of *Microcystis* are perhaps the most common algae that develop as water-blooms in fresh water. The 'simple' structure of these plants, their infinite morphological variability, and their universal distribution in temperate and tropical zones have made them favorite subjects for the description of 'new species'. The most important recent discussion of the group is that of Crow in *New Phytologist*, vol. 22 (1923), a study of material collected in Ceylon and an evaluation of figures and descriptions found in a rather limited mass of literature.

This study was begun as an inquiry into the reliability of the many old and recent descriptions of species in the group. More than a thousand specimens on file in American and European herbaria and in the personal collections of many living collectors were assembled, and observations were made upon the morphology of the plants in each specimen. An attempt was then made to arrange all of the specimens in groups sufficiently homogeneous to deserve specific appellations. Much of the material examined was in the dried condition; quite as much was seen in formalin, alcohol, and other liquid preservatives. The lot included specimens upon which the original descriptions of most of the commonly reported species were based, as well as those which illustrate the specific distinctions made by important students of the algae. Field observations were made upon living plants during a period of several years.

## Morphology

The three species of the genus as here circumscribed are rather similar in structure. The plant body is composed usually of many cells. Each cell consists of a spherical protoplast surrounded by a layer of structureless hyaline gelatinous material which is confluent with that of the neighboring cells. The protoplasm is blue-green and contains large irregular granules, the pseudovacuoles, which appear black in transmitted light and red in reflected light. Where the plants are subjected to certain changes in the environment or to long-continued immersion in liquid preservatives, the pseudovacuoles disappear and the protoplasm becomes almost homogeneous. The

cell membrane is thin, conspicuous in some plants, scarcely evident in others. The gelatinous material, termed the *sheath* in myxophycan parlance, is so homogeneous throughout the plant body that it is impossible to demonstrate with the usual staining methods just what part of it belongs properly to each individual cell. In most plants, this material is firm; it holds the protoplasts in more or less permanent positions within the plant body. In many, it is so firm, and its outer layer so highly refractive, that it is conspicuously delimited from the surrounding medium. In others, its outer limits are so indefinite as to be made visible only by careful staining techniques; in such plants, bacteria and the organisms passing under the name of *Phormidium mucicola* Naum. & Huber. are often abundant in the diffuent outer layer of gelatinous material. All gradations between forms which are conspicuously delimited and those which are most indefinitely so are illustrated in most collections.

The plant bodies are highly variable in shape and size. In certain collections, especially those in which the plants are scarce in the plankton, spherical plants predominate. In other collections, especially those from heavy water-blooms, the plants are of all conceivable shapes: spherical, ovoid, cylindrical, torulose, lobed, branched, and perforated. Other collections contain chiefly elongated and narrowly cylindrical branching plants. A variation of this type includes those in the form of branching chains of spherical, ovoid, or lobed cell-masses. A peculiar form is seen in certain rare collections, in which the plant bodies or their lobes consist of very few cells, so that the protoplasts appear to be grouped vaguely in eights. In certain collections, the protoplasts are distributed only in the periphery of the plants or their lobes and in general arrangement are reminiscent of those of species of *Coelosphaerium*. In very heavy water-blooms of *M. aeruginosa*, compact masses as great as several centimeters in thickness may be formed, with the individual plants agglutinated and the gelatinous material of each confluent with that of neighboring plants. Every type of plant body described above, with infinite variation, is exemplified in most collections, often in the same field of the microscope. One cannot (unless arbitrarily) select out of the diversity of shapes represented in a plankton haul a single shape which is 'typical' of a species, for all shapes appear to be characteristic of each species. In all the material studied, the size of plants and protoplasts, the degree of diffuence of the gelatinous material, the color of the protoplasm, the aspect of the pseudovacuoles, and the appearance of

the cell membranes illustrate all gradations between wide limits of variability.

Alteration in the appearance of plants occurs commonly during collecting, preserving, and storing of material. Plants lifted gently from the habitat and examined at once under the microscope often differ in shapes from those collected in a tow-net; it is probable that pressure of the water and friction of the plants with each other and with the sides of the net bring about such changes. If the collection is preserved immediately by rapid drying, the color and granulation of the protoplasm, the pseudovacuoles, the cell membranes, and the gelatinous matrices retain permanently (at least under usual conditions of storage in herbaria) the appearance characteristic of the plants when collected; such changes as do occur are confined to flattening of the protoplasts. If, after being collected, the material is preserved at once by the addition of formalin or alcohol, the plants likewise retain the aspect of living ones; however, if they are stored in this manner for a year or more, pseudovacuoles often disappear, the color of the mass is lost, the cell membranes become indistinct, and the protoplasts become dissociated from each other. Pseudovacuoles soon disappear where living plants are kept for some hours in closed bottles before they are preserved; often the mass assumes a yellowish color under such conditions. Here a lack of oxygen may be responsible for changes in appearance. Bacteria multiply in such collections, and by their action the outlines of the plants are altered. Exposure of such collections to direct sunlight before preservation causes similar pathological effects. Differences in morphology of plants and protoplasts in preserved collections may thus be attributed to the treatment of material during and after its removal from the habitat, and the preserved material may bear little resemblance to living material in the mass from which it was taken. Pressure and friction involved in the collecting with nets, exclusion of oxygen from the living plants after collecting, overheating, over-sufficient exposure to direct sunlight, and long standing in liquid preservatives may bring about radical changes in the appearance of the plants.

We may assume that these same 'unfavorable' conditions are duplicated in ponds, lakes, and streams which give rise to waterblooms of *Microcystis*. In every mass of plants in the plankton the individuals are constantly moving with currents of water or in response to the force of gravity. Large numbers of plants may live throughout the season under presumably optimum conditions in

the limnoplankton. Others may settle to the bottom and there in a medium deficient in oxygen become pathological or die. Both dead and dying individuals may again be carried into the limnoplankton and mixed with the mass as collected. Plants may be carried by waves onto shores, where they pile up and are exposed to overheating and direct sunlight; these also may be washed back into the limnoplankton and form part of the mass which is collected. Plants exposed to the direct sunlight in very shallow water may become pathological and later be mixed with the mass collected. In fact, collections are often taken from shallow water or from shores rather than from the limnoplankton. A well developed water-bloom of these organisms, we may therefore assume, is composed of millions of individual plants, each with a slightly different individual history, each unique in the appearance of all of its parts according to the 'adverse' and 'favorable' conditions to which it has been exposed during its own, and probably its ancestral, history.

Reproduction in the genus is by fragmentation of the plant bodies. Lobes consisting of several or many cells are formed, or in filamentous plants spherical or ovoid aggregations of cells appear as segregated masses within the plant body. As the cells divide and increase in size, the lobes and aggregations of cells increase in size and ultimately become separated from the other parts. In rare instances, single cells are seen to form such lobes or separated fragments. Fragmentation may also be brought about by mechanical action of various agents before, during, or after collecting. Under favorable conditions, cell division and reproduction take place so rapidly that millions of individual plants appear in the plankton within a short period of time; these floating to the surface constitute the peculiar mass termed *water-bloom*.

For taxonomic and morphological studies, the method of preservation here recommended, as with all other Myxophyceae, is by drying as quickly as possible on both paper and mica as soon as the material is collected. The disadvantages of preservation in formalin and alcohol have been mentioned above.

### The Species

An exhaustive treatment of the genus *Microcystis* Kütz. must await the work of a monographer who can study as a whole the generic complex *Microcystis*-*Aphanocapsa*-*Aphanothece*. If the planktonic freshwater species of *Microcystis* are to be segregated as a distinct genus, as our studies here lead us to suppose, they must

perhaps be designated by the generic name *Polycystis* Kütz., Tab. Phyc. 1: 7 (1846). Species with elongated cells should be transferred to *Aphanothece*. Those which have spherical cells and bodies of indeterminate growth and sedentary habit are more properly placed in *Aphanocapsa*.

In the group of species here circumscribed are those Myxophyceae whose plant bodies contain few to many spherical protoplasts arranged without regular order within homogeneous, hyaline gelatinous matrices of microscopic size and diverse shapes; all are planktonic and unattached to substrata even in juvenile stages. Those species previously described in *Microcystis* which, from an examination of their original specimens, prove to be members of other genera are listed as *Nomina Excludenda* at the end of the treatment of species below. Those for which no authentic material has been seen and which from their figures and descriptions appear to belong to other groups are listed as *Nomina Inquirenda*.

Herbaria and private collections in which specimens cited are to be found are indicated by means of the following abbreviations: B, Brooklyn Botanic Garden; Ber, Botanisches Museum, Berlin-Dahlem; BM, British Museum (Natural History); C, Herbarium of the University of California; D, Herbarium of Francis Drouet; Da, Herbarium of W. A. Daily; F, Farlow Herbarium of Harvard University; FM, Field Museum of Natural History; G, Herbarium of Goucher College, Baltimore; K, Botanisk Museum, Kjøbenhavn; L, Rijksherbarium, Leiden; Mi, Herbarium of the University of Michigan; Min, Herbarium of the University of Minnesota; Mo, Missouri Botanical Garden; N, New York Botanical Garden; Ne, Herbarium of the University of Nebraska; Pa, Academy of Natural Sciences, Philadelphia; Pr, Herbarium of G. W. Prescott; PW, collection of Philip W. Wolle in Field Museum of Natural History; S, Naturhistoriska Riksmuseet, Stockholm; T, Herbarium of Wm. R. Taylor; Ta, the collection of C. E. Taft; U, United States National Herbarium.

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Rosalie Weikert and Mr. G. Wittrock have given assistance in the bibliographic work.

The following key may be of assistance in the determination of species in samples where the plants occur in abundance:

- I. Mass developing in loose granular layers in shallow waters of ponds fed by limestone springs; protoplasts bright blue-green, 2-3  $\mu$  in diameter, pseudovacuoles absent. . . . . M. GLAUCA
- II. Mass strictly planktonic and often developing as heavy water-blooms; pseudovacuoles present (often absent in material preserved in formalin or alcohol)
  - A. Protoplasts 0.5-2  $\mu$  in diameter, pseudovacuoles small and inconspicuous . . . . . M. INCERTA
  - B. Protoplasts 2.5-10.5  $\mu$  in diameter, pseudovacuoles large and conspicuous . . . . . M. AERUGINOSA

**MICROCYSTIS glauca** (Wolle) Drouet & Daily, **comb. nov.**  
*Anacystis glauca* Wolle, Bull. Torr. Bot. Club 6: 182 (1877).—Here possibly belong, if we can judge by descriptions and figures, the following: *Pleurococcus pulvereus* Wood, Smiths. Contrib. Knowl. 241: 79 (1872); *Anacystis pulvereae* Wolle, F. W. Alg. U. S., 329 (1887); *Polycystis pulvereae* Wolle apud Hansg., Prodr. Alg. Fl. Böhmen 2: 145 (1892).

Plantae multi-(raro 1-pauci-)cellulares, forma variabilissimae, sphaericae, ovoideae, cylindricae, varie et irregulariter lobatae vel invaginatae, saepe clathratae, toruloso-cylindricae, aut conferte confluentes, in 'strato indeterminato fundis calcariorum fontium' (sec. Wolle) invenientes; protoplastidibus globosis aut in divisione fere hemisphaericis, 2  $\mu$  ad 3  $\mu$  crassis, sine ordine regulari in gelatino vaginali distributis; gelatino vaginali hyalino, homoganeo, ad marginem distincte delimitato vel plus minusve (nonnumquam omnino) diffuenti; protoplasmate laete aerugineo, non granuloso, sine pseudovacuolis (v. s.).

Specimens seen: PENNSYLVANIA: in fonte rupium calcareorum ad Bethlehem, F. Wolle, 1884 (TYPE in Wittr. & Nordst., Alg. exs. 796, PW; isotypes, L, N, Ne); lime stone springs, F. Wolle (L); '*Anacystis glauca*' (N).

Mr. Philip W. Wolle has made the following transcript of the two entries in Francis Wolle's notebooks: "October 25, 1877. *Anacystis glauca*, n.sp. Glaucous green, covers the bottoms of ponds of lime stone spring water. Thallus of families, gelatinous, colorless, soon diffused, oval or ovate, discernible by various degrees of density of cellules rather than by a distinct outline. Cells very small and very numerous, light aeruginous. Family .005" more or less. Cellules .00008-.0001 rarely .000116." Collected in Sheimer's Spring

[near Bethlehem, Pennsylvania]. In large masses on the bottom of fresh lime stone water ponds, tea green—dipped it up by mug fulls. Teg. gelatinous, colorless, hardly discernible except by particles of dirt adhering." "September 23, 1884. *Anacystis glauca*,—cells .00012—.00014". Cysts diffuent, quickly diffuse, forms a dense deposit in lime stone springs, glaucous green color, very slightly gelatinous, necessary to add gum water to make it adhere to paper—this changes color to darker green. Pond water—Farmersville [near Easton, Pennsylvania]". The copious and well preserved material left by Francis Wolle shows beyond doubt that this species is one of *Microcystis*. It is a kind of plant, however, very different from that popularly reported in the limnoplankton of ponds and lakes throughout the world under the name *M. pulvereae*. The latter receives treatment below under *M. incerta* Lemm. Wolle, in his *Fresh-water Algae of the United States* (1887), identified his *Anacystis glauca* with *Pleurococcus pulvereus* Wood. It is now certain that Wolle had only Wood's original description of *P. pulvereus* upon which to base this decision. Wood's description appears to be somewhat ambiguous; the location of his herbarium is unknown to us at the present time. It has therefore seemed advisable to accept Wolle's *Anacystis glauca* as the first name to designate the species with certainty.

MICROCYSTIS INCERTA Lemm., Kryptogamenfl. Mark Brandenb. 3: 76 (1907). *Polycystis incerta* Lemm., Forschungsber. biol. Sta. Plön 7: 132 (1899). *Clathrocystis holsatica* Lemm., ibid. 10: 150 (1903). *Microcystis holsatica* Lemm., Kryptogamenfl. Mark Brandenb. 3: 77 (1907). *M. pulvereae* var. *incerta* Crow, New Phytol. 22: 66 (1923). *M. pallida* Mig., Krypt. Germ. Austr. Helvet. Exs. 52 (Algen): 264 (1931).—Here belong also, if we can judge by original descriptions and figures, the following: *Polycystis pallida* Lemm., Bot. Centralbl. 76: 154 (1898); *P. stagnalis* Lemm., Ber. deutsch. bot. Ges. 18: 24 (1900); *Microcystis stagnalis* Lemm., Forschungsber. biol. Sta. Plön 10: 150 (1903); *M. incerta* var. *elegans* Lemm., loc. cit. (1903); *Clathrocystis holsatica* var. *minor* Lemm., Abh. Nat. Ver. Bremen 18: 151 (1905); *Microcystis holsatica* var. *minor* Lemm., Kryptogamenfl. Mark Brandenb. 3: 77 (1907); *M. pulvereae* var. *incerta* f. *elongata* Crow, loc. cit. (1923); *M. exigua* Zalesky, Rév. gén. Bot. 38: 34 (1926).

Plantae multi-(raro 1-pauci-)cellulares, forma variabilissimae, sphaericae, ovoideae, cylindricae, varie et irregulariter lobatae vel invaginatae, saepe clathratae, toruloso-cylindricae, aut conferte

confluentes, inter alias algas planctonicas sparsae, demum denso 'flori aquae' invenientes; protoplastidibus globosis aut in divisione fere hemisphaericis,  $0.5\ \mu$  ad  $2\ \mu$  crassis, sine ordine regulari in gelatino vaginali distributis; gelatino vaginali hyalino, homoganeo, ad marginem distincte delimitato vel plus minusve diffuenti; protoplasmate pallide aerugineo, pseudovacuolis parvis praebentibus (v. v., v. s., v. in form.).

Specimens seen: SWEDEN: in lacu Wombsjon Scaniae, O. Nordstedt, Jun. 1901 (as *M. incerta* det. Lemmermann. Ber. C, N); duck pond, Lovestad, B. Carlin-Nilsson, July 1934 (D). BRANDENBURG: Teich bei Furstenfelde bei Neudamm, Itzigsohn & De Bary, Sept. 1852 (as *Clathrocystis holsatica* det. Lemmermann, Ber). THÜRINGEN: im Plankton des Prinzenteichs, Eisenach, W. Migula, Aug. 1931 (ISOTYPES of *Microcystis pallida* Mig., Krypt. Germ. Austr. Helv. Exs. 264, Ber. F, FM, N, T). TRANSVAAL: tow netting in channel, Barberspan, Mrs. G. E. Hutchinson 4, Apr. 1928 (D). MINNESOTA: with *M. aeruginosa*, Heron Lake, Jackson County, Minnesota Fish Commission, July 1938 (FM). BRAZIL: with *M. aeruginosa*, Açude Velho near Campina Grande, Parahyba, S. Wright 1570, Mar. 1935 (D).

*M. incerta* is seldom encountered in files of herbarium specimens. It has been mentioned in the literature mainly by workers whose specimens are rarely placed in herbaria. Because of the small size of the protoplasts, it is easily confused with coccoid planktonic bacteria. Usually but few plants are seen in the plankton of a lake; less usually they develop into heavy water-blooms, as in the specimen cited above from Brandenburg and labeled *Clathrocystis holsatica* by Lemmermann.

MICROCYSTIS AERUGINOSA Kütz., Tab. Phyc. 1: 6 (1846). *Microhaloa aeruginosa* Kütz., Linnaea 8: 371 (1833). *M. ichthyoblabe* Breb. in Menegh., Monogr. Nostoch. Ital. 104 (1842). *Microcystis ichthyoblabe* Kütz., Phyc. Gener. 170 (1843). *Polycystis aeruginosa* Kütz., Tab. Phyc. 1: 9 (1846). *Polycystis ichthyoblabe* Kütz., ibid. 9 (1846). *Clathrocystis aeruginosa* Henfr., Trans. Microsc. Soc. London N. S. 4: 53 (1856). *Polycystis viridis* A. Br. in Rabenh. Alg. Eur. 21: 1415 (1862). *P. prasina* Wittr. in Wittr. & Nordst., Alg. Aq. Dulc. Exs. 6: 297 (1879). *P. flos-aquae* Wittr., ibid. 298 (1879). *Microcystis caerulea* Dickie, Journ. Linn. Soc. Bot. 18: 128 (1880). *Polycystis scripta* Richt. in Hauck & Richt., Phyk. Univ. 2: 92 (1887). *P. flos-aquae* var. *scripta* Hansg., Prodr. Algenfl. Böhmen 2: 144 (1892). *P. flos-aquae* var. *prasina* Hansg., loc. cit. (1892). *P. elabens* var. *ichthyoblabe* Hansg., ibid. 145 (1892). *P. aeruginosa* var. *major* Wittr. apud Hansg., loc. cit. (1892). *P. (Clathrocystis) insignis* Beck, Krypt. Exs. Mus. Vindob. 2: 227 (1896). *P. ochracea* Brand, Ber. Deutsch. Bot. Ges. 16: 200 (1898). *Microcystis viridis*

Lemm., Abh. Nat. Ver. Bremen 17: 342 (1903). *M. prasina* Lemm., Ark. f. Bot. 2 (2): 146 (1904). *M. flos-aquae* Kirchn. apud Lemm., Kryptogamenfl. Mark Brandenb. 3: 75 (1907). *M. scripta* Lemm., ibid. (1907). *M. ochracea* Lemm., ibid. 3: 76 (1907). *Clathrocystis robusta* Clark, Proc. Biol. Soc. Wash. 21: 94 (1908). *Microcystis aeruginosa* var. *major* G. M. Smith, Trans. Wisc. Acad. 18: 535 (1916). *M. robusta* Nygaard, Dansk Bot. Ark. 4 (10): 8 (1925). *M. aeruginosa* f. *occidentalis* Wm. R. Tayl., Amer. Journ. Bot. 15: 606 (1928).—Here also should be placed the following, if we can judge by original descriptions and figures: *Polycystis marginata* var. *minor* Hansg., Prodr. Algenfl. Böhmen 22: 145 (1892); *Microcystis protocystis* Crow, New Phytol. 22: 62 (1923); *M. pseudofilamentosa* Crow, ibid. 64 (1923); *M. fusca* Zalessky, Rev. Gén. Bot. 38: 33 (1926); *M. elabentoides* Zalessky, loc. cit. (1926); *M. floccosa* Zalessky, ibid. 34 (1926); *M. globosa* Zalessky, loc. cit. (1926); *M. angulata* Zalessky, loc. cit. (1926); *M. ramosa* Bharadw., Proc. Indian Acad. Sci. 2: 96 (1935).

Plantae multi-(raro 1-pauci-)cellulares, forma variabilissimae, sphaericae, ovoideae, cylindricae, varie et irregulariter lobatae vel invaginatae, saepe clathratae, toruloso-cylindricae, aut conferte confluentes, primum inter alias algas planctonicas sparsae, demum denso 'flori aquae' invenientes; protoplastidibus globosis aut in divisione fere hemisphaericis,  $2.5\ \mu$  ad  $10.5\ \mu$  crassis, sine ordine regulari in gelatino vaginali distributis; gelatino vaginali hyalino, homoganeo, ad marginem distincte delimitato vel plus minusve (saepe omnino) diffuenti; protoplasmae aeruginoso, pseudovacuolis praebentibus (v. v., v. s., v. in form.)

Specimens seen: LATVIA: Prov. Kurzeme, *H. Skuja*, Aug. 1924 (Da, FM). SWEDEN: in lacu Kälungen Daliae, *V. Wittrock*, Aug. 1866 (ISOTYPES of *Polycystis flos-aquae* Wittr., in Wittr. & Nordst. Alg. exs. 298, L, Min, N, Ne, PW), Sept. 1882 (Wittr. & Nordst., Alg. exs. 599, D, L, Min, N, Ne, PW); pond, Nötesjö, Malmöhus, *B. Carlin-Nilsson* 525, Aug. 1937 (D, N); Dagstorpssjön, Malmöhus, *Carlin-Nilsson* 140, Aug. 1931 (D, N); in lacu Lötsjön par. Funbo Uplandiae, *V. Wittrock* (Aresch., Alg. Scand. Exs. Ser. Nov. 429, FM, L), Oct. 1878 (Wittr. & Nordst., Alg. exs. 296, FM, L, Mi, Ne, PW); lake, Fiolen, Kronoberg, *Carlin-Nilsson* 516, July 1937 (D, N); in lacu Kälungen in Dalia, *Wittrock* (Aresch., Alg. Scand. Exs. Ser. Nov. 388, as *Aphanocapsa pulchra*, FM), Aug. 1862 (D); in lacu Mälaren ad Flottsund Uplandiae, *Wittrock*, Nov. 1878 (ISOTYPES of *Polycystis prasina* Wittr., in Wittr. & Nordst., Alg. Exs. 297, FM, L, Mi, Ne, PW, T, U); Hammarbysjö in Danviken, Stockholm, *G. Lagerheim*, 1882 (D); in lacu ad Mullsjö Vestrogothiae, *O. Nordstedt*, Aug. 1900 (Ber, N); Trehörningsjö, Upland, *O. Borge*, Sept. 1896 (N); with *Microcystis incerta*, in lacu Wombsjön Scaniae, *Nordstedt*, Jun. 1901 (C, N). DENMARK: in lacu prope Birkerød, Selandia, *C. Ostenfeld-Hansen*, Aug. 1896 (D, K); Sjöen Naerum, *C. Rasch*, Jun. 1880 (K); Lillerød,

Sjaelland, *Th. Rosenvinge*, Sept. 1879 (K); Hut-so, *Johs. Schmidt*, Sept. 1898 (K); Hofmansgave, Fionen, *Hofmann-Bang* (B). DANZIG: *Klinsmann*, 1858 (Ber).

GERMANY: Ostpreussen: Ockelsee bei Allenstein, *Caspary*, Aug. 1862 (Ber.). Westpreussen: Sawadda-See, *P. Hennings*, Sept. 1890 (Ber). Brandenburg: Wannensee, *Hennings*, Sept. 1892 (Henn. Phyk. March. 47c, Ber, F); Halensee, *Hennings*, Nov. 1890 (Henn. Phyk. March. 47b, Ber, F); Wilmersdorfer See (Berlin), *Hennings*, Juli 1882 (Ber; Henn. Phyk. March. 47a, Ber, F); Muggel-See, Friedrichshagen, *Hennings*, Aug. 1892 (Ber), Sept. 1892 (Henn. Phyk. March. 47d, Ber, F), *A. Braun* (Ber); in der Havel bei der Pfaueninsel, *Braun*, Aug. 1863 (Ber, Caput gegenüber, Oct. 1855 (Ber), bei Potsdam, *Bauer*, Aug. 1863 (Ber, D, L, F, N), *L. Rabenhorst*, Juli 1857 (L); Berlin, *Braun*, Aug. 1854 (Ber, L), *Jahn*, 1857 (Ber), Hort. Berol., *Braun*, Aug. 1852 (Ber); Golssen, *Schumann*, Juli 1865, 1866 (Ber); Grunewald-See bei Berlin, *G. Hieronymus*, Aug. 1891 (Ber); in einem Graben bei der kleinen Muhle, Neudamm, *Itzigsohn*, Mai 1855 (Ber); Gumnitzsee, Joachimsthal, *W. Panknin*, Aug. 1937 (Ber); im Tempelhofer Parkteiche bei Berlin, *Hennings*, Juli 1883 (Ber; Henn. Phyk. March. 46, Ber, F). Pommern: Wolgast-See bei Haeringsdorf, *A. Braun*, Sept. 1864 (Ber, L). Sachsen: aus cinem Teiche in Bernbruch bei Lausigk, *P. Richter*, Juli 1864 (Rabenh. Alg. 1791, as *Coclosphaerium Kuetzingianum*, FM); Mannsfeld, *M. Marsson*, Juli 1896 (N); Leipzig, Lindenuau, *Marsson*, Sept. 1897 (N); Teich in Collau am Mulde, *Marsson*, Sept. 1897 (N); in Gohlis bei Leipzig, *Richter*, Sept. 1878 (N), *Auerswald*, Sept. 1852 (Ber); Leipzig, *Richter* (FM); in lacu salso Mansfeldensis prope Halam Borussiae (TYPE of *Polycystis scripta* Richt. in Hauck & Richt. Phyk. Univ. 92, Ber; Isotypes, L, Min); Brosen bei Grimma, *Richter*, Aug. 1894 (Hauck & Richt. Phyk. Univ. 748a, L, Min, N); in einem Teiche bei Anger, Leipzig, *Richter*, Aug. 1879 (L, Pa, T); auf Teichen, Moritzburg (L); auf einem Fischteiche, Ponikau, *Auerswald* (Ber, F, FM, N), Juli 1852 (Rabenh. Alg. 210, Ber, FM, L, Min, N, Ne); in einem Teiche, Leipzig, *Auerswald* (FM); Lipsiae, *Kunze* (TYPE of *Microcystis ichthyoblabe* Kutz., Ber; Isotypes, FM, N, Pa); in einem Graben am Grossen Garten in Dresden, *C. Schiller*, Juli 1888 (Hauck & Richt. Phyk. Univ. 296b, L, Min); Schadebach bei Makranstadt (Leipzig), *H. Reichell* (Hauck & Richt. Phyk. Univ. 297, L. Min). Thuringen: Georgenthal, in einem Teich am Bahnhof, *W. Migula*, Sept. 1928 (FM; Mig. Krypt. Germ. Austr. Helv. Exs. 242, T); Burgsee bei Salzungen, *A. Braun*, Sept. 1862 (TYPE of *Polycystis viridis* A. Br., Rabenh. Alg. 1415, FM, L, Min, N, Ne); Salzunger See, *A. Rose* (Rabenh. Alg. 453, as *Microhaloa firma*, F, FM, L, N, Ne); Salzsee bei Halle, *O. Kuntze* (N). Bayern: Nurnberg, *P. Reinsch* (Mi); in Wassertumpeln bei Erlangen, *Gluck*, Sept. 1895 (L, U); Erlangen, *Reinsch* (N, U); Wurmsee, *F. Brand*, Sept. 1897 (ISOTYPE of *Polycystis ochracea* Brand, Ber). Ostermark: Vindobonae in piscinis hortorum publicorum, *K. Rechinger* (Krypt. Exs. Mus. Vindob. 2335, Ber, L, N); Vindobonae in piscinis horti Caesarei Schonbrunn, *C. de Keissler* (Krypt. Exs. Mus. Vindob. 1517, Ber, L, N, U). Schlesien: Galgenberge bei Strehlen, *Hilse* (Ber; Rabenh. Alg. 1522, Ber, FM, L, N, Ne), in Rohrteiche, *Hilse*, Juli 1859 (Rabenh. Alg. 1174, Ber, FM, Min, N, Ne), Strehlen, *Hilse* (Ber, L); bei Habendorf, *Hilse* 8 (Ber); am Gross-teiche von Habendorf bei Reichenbach, *Hilse*, Sept. 1862 (Ber); Rausern bei Breslau, *W. Migula*, Juli 1877 (Hauck & Richt. Phyk. Univ. 296a, L, Min), Mai 1887 (Mig. Krypt. Germ. Austr. Helv. Exs. 30, Mi, N, T); Breslau, *O. Kirchner*, 1874 (Rabenh. Alg. 2424, L, Min. N, Ne, T); im Teiche bei Schoffschutz in Oberschlesien, *A. Utgenannt & S. Schmula*, Sept. 1895 (Hauck & Richt. Phyk. Univ. 684 as *Polycystis elabens*, L, Min, N); grosser Teich in Buchwald bei Schmiedeberg,

*G. Hieronymus*, Sept. 1887 (Ber). Hamburg: an der Aussen-Alster, *P. Hennings*, Aug. 1886 (Ber). Baden: Schwetzingen, *Mettenius* (Ber). Wurttemberg: Stuttgart, bassins du Jardin Royal, *G. v. Martens* (L), in den Seen des Schlossgartens, *Martens* (Ber, L, N), *Hohenacker* (Ber); Stuttgart, *Martens* (TYPE of *Microcystis aeruginosa* Kutz., L; Isotype, Ber), Juni 1827, Aug. 1830, Aug. 1847 (Ber).

MORAVIA: près Eisgrub (L). HUNGARY: in excavationibus 'Lágymányosi holt Dunaág', Budapest, *F. Filarszky*, Mai 1911 (Fl. Hungar. Exs. 1 (Alg. 1): 21, FM, L, U); in lacu 'Városligeti tó', Budapest, *Filarszky* (Krypt. Exs. Mus. Vindob. 226, Ber, L, N). ITALY: Trieste, *F. Hauck* (D, F, N). NETHERLANDS: Haagsche Bosch, den Haag, *W. F. R. Suringar* D18, Mei 1857 (D, L); Witte Singel, Leiden, *J. T. Koster* 233, Aug. 1938 (L); in aq. dulc. stagn., Lugd.-Batav., *van den Bosch* 376, Aug. 1846 (L), idem, in stagnis pr. Leyden (Ber); Holland, *Weber van Bosse*, Oct. 1891 (L); forest, The Hague, *W. Trelease*, June 1884 (Mo). FRANCE: Falaise, Calvados, *A. de Brébisson* 594 (L), dans les cavités des rochers, *Brébisson* 528 (L), flottant sur les eaux, *Brébisson* (Ber); Carentan, Manche (Ber); Angers, Maine-et-Loire, *F. Hy* (Ber).

PORTUGUESE EAST AFRICA: Maloti Lake near Masiyeni, *S. Chopiland*, *E. L. Stephens* 33, June 1928 (D, N). SOUTH AFRICA: Rietkuil, Bethal Dist., East Transvaal, *M. E. Blenckiron & D. Weintraub* 24, Feb. 1928 (D).

MASSACHUSETTS: Arlington, *E. Dewart* (N); Horn Pond, Woburn, *W. G. Farlow*, Aug. 1879 (D, F); Fresh Pond, Cambridge, *H. H. Barlett* 1179, Oct. 1907 (Mi), *Farlow*, Oct. 1882 (F, Mo), *G. T. Moore*, Oct. 1893 (B); Hammond Pond, Newton, *H. M. Richards*, Oct. 1889 (N), *W. A. Setchell* (F); Basin No. 3, Framingham, *Farlow*, Nov. 1881 (F); Brockton Water Works, *Supt.*, July 1887 (G); Oyster Pond, Falmouth, *A. W. Evans*, July 1896 (G); *Wm. R. Taylor*, Aug. 1922 (FM, Mi), *J. Bader*, July 1938 (D), *Drouet* 2118, July 1937 (D, F, N, S); 'Episcopal Ocean', Falmouth, *E. T. Rose & Drouet* 1867, July 1936 (D, N, S), *R. N. Webster*, June 1938 (D, F, N), *J. Bader*, July 1938 (D), *C. M. Palmer*, Sept. 1937 (Da, FM); Fresh Pond, Falmouth, *Wm. R. Taylor*, July 1921 (T); Long Pond, Nantucket, *Taylor & B. F. D. Runk*, July 1938 (D); north head of Hummock Pond, Nantucket, *Taylor* (D), 1920 (T); pond 1 mile south of Nonquitt, Dartmouth, *Rose & Drouet*, July 1936 (D); pond, Cuttyhunk Island, *F. S. Collins* 5723, Aug. 1907 (N); Ludlow Reservoir, Springfield, *Farlow*, Aug. 1876 (F). RHODE ISLAND: Mashapaug Pond, Providence, *W. J. V. Osterhout*, Oct. 1892 (Phyc. Bor.-Amer. 51, FM, L, Mi, Min, N, Ne); Providence, *Nichols*, June 1877 (D, F); Haley's Pond, Cranston, *Collins* 6444, Sept. 1911 (N). NEW YORK: Central Park, New York, July 1865 (Ber). PENNSYLVANIA: pond north of Kennett Square, *F. W. Pennell & W. S. May*, Oct. 1921 (T).

OHIO: Lake Erie, *L. H. Tiffany*, Aug. 1936 (FM), 1929 (FM), Put-in-Bay, *C. E. Taft*, Aug. 1938 (Da, FM, Taft); Goodale Park, Columbus, *E. H. Ahlstrom*, Oct. 1933 (Da, FM). KENTUCKY: pond near Walton, Boone County, *B. B. McInteer* 13, Aug. 1929 (Da, FM); sandpit, Greenwood Road near Louisville, *H. Bishop*, Oct. 1931 (Da, FM). TENNESSEE: Percy Warner Lake, Nashville, *H. C. Bold* 13, 1933 (FM); Radnor Lake, *Bold*, Oct. 1936 (FM). MICHIGAN: Pasinski Pond, Genoa Township, Livingston County, *W. F. Carbine*, 1938 (FM, T); Lake George, Oakland County, *C. E. Taft* 155, Aug. 1936 (Da, FM, Taft); with *Phormidium mucicola*, McDonald Lake, Yankee Springs, Hastings, *G. T. Velasquez*, Aug. 1936 (D, T); Three Lakes, Ann Arbor, *L. N. Johnson*, Sept. 1892 (F, N, Ne). INDIANA: Winona Lake, *C. M. Palmer* 162, B436, Aug. 1935 (D, Da, FM); Crooked

Lake, Steuben County, *Palmer B50*, Sept. 1933 (Da, FM); Lake Freeman, Carroll County, *Daily*, July 1938 (Da, FM); Beaver Dam Lake, 4 miles north of Silver Lake, Kosciusko County, *Daily 82*, June 1939; Calumet River north of Miller Station, Lake County, *P. D. Voht & Drouet 2367*, Sept. 1938 (FM, N). WISCONSIN: Madison, Fourth Lake, *Wm. Trelease*, 1882 (Mo), Spooner Lake, *Trelease* (Mo), Lake Mendota, *Trelease*, 1882 (D, F, Mo); Pleasant Lake, near Lauderdale Lakes, *G. W. Prescott 3W28*, Aug. 1938 (FM, Pr); High Lake, Vilas County, *Prescott 2W59*, June 1937 (FM, Pr); North Twin Lake, Polk County, *G. M. Smith*, Aug. 1917 (FM, Pr); Fish Lake, Burnett County, *Smith* (FM, Pr); pond east of Wild Rose near Silver Lake, *Prescott 2W330*, July 1937 (FM, Pr); Alequash Lake, *Prescott W155*, Aug. 1936 (FM, Pr), *2W268*, July 1937 (FM, Pr); Silver Lake, in Silver Lake, *E. H. Ahlstrom*, June 1932 (Da, FM). ILLINOIS: Lake County, Petit Lake near Antioch, Fox Lake, Lake Zurich, Slocum Lake 2 miles west of Wauconda, Pishtaka (or Pistakee?) Lake, Diamond Lake, Lake Marie near Antioch, *E. H. Ahlstrom*, June 1932 (Da, FM).

MINNESOTA: Lake of the Isles, Minneapolis, *K. Damann*, Aug. 1936 (Da, FM); Como Park, St. Paul, *J. E. Tilden*, Aug. 1895 (Tild. Amer. Alg. 194B, Ber, FM, Min, N, Ne, U); Long Lake, Hennepin County, *B. T. Shaver & Tilden*, Sept. 1895 (Tild. Amer. Alg. 194A, Ber, FM, Min, N, Ne, U); Lake at Waterville, *J. C. Arthur*, July 1882 (F); Fountain Lake, June 1936, Bowstring Lake, Chippewa National Forest, July 1936, Round Lake, July 1938, McCarron's Pond, Aug. 1931, Cross Lake just north of Minneapolis, Sept. 1936, Kandiyohi Lake, Sept. 1938, Iowa Lake, Aug. 1938, Ottertail Lake, Sept. 1938, Heron Lake, Jackson County, July 1938, *C. B. Reif comm. ex Coll. Bur. Fish.* (Da, FM). IOWA: Center Lake, *Prescott 317*, July 1925 (D, N); Miller's Bay, Lake Okoboji, *Prescott 316*, June 1925 (D, N); Lake East Okoboji, *Prescott 338*, June 1926 (D). MISSOURI: St. Louis, *G. T. Moore*, Aug. 1913 (D); plankton of lake, Pertle Springs, Warrensburg, *Drouet 778*, Oct. 1930 (D); Agriculture Pond, Columbia, *Drouet 990*, July 1932 (D). LOUISIANA: pond in pasture 1 mile northwest of Baton Rouge, *Prescott La17*, June 1938 (D). NEBRASKA: Cherry County, Hackberry, Dewey, and Watts Lakes, *E. R. Walker & E. N. Andersen*, July 1912 (Ne), Hackberry Lake, *E. Palmatic*, July 1936 (Ne). KANSAS: stagnant pond, Pittsburg, *R. Patrick*, Sept. 1938 (FM). COLORADO: Barr Lake, Adams County, *R. Prettyman*, July 1939 (FM). UTAH: *M. E. Jones*, 1895 (F); Strawberry Reservoir, Wasatch County, *Utah Party, U. S. Bur. Fish. comm. S. Wright*, Mar. 1933 (FM), *A. S. Hazzard F16*, Aug. 1933 (FM). ARIZONA: Station 13, Mary's Lake, Flagstaff, *H. S. Colton*, 28 Aug. 1923 (TYPE of *Macrocystis aeruginosa* f. *occidentalis* Wm. R. Taylor, T). WASHINGTON: Green Lake, Seattle, *N. L. Gardner*, Dec. 1903 (Phyc. Bor.-Amer. 1153, FM, I, Mi, Min, N, Ne, T, U); Fidalgo Island, *L. E. Griffin*, Summer 1938 (FM).

GUATEMALA: Lake Amatitlan, *S. E. Meek 1* (TYPE of *Clathrocystis robusta* Clark, FM), 9, 11, 16, 21, 25, Feb. 1906 (FM). PANAMA CANAL ZONE: Barro Colorado Island, *A. M. Chickering*, Aug. 1936 (D, F, L, N, Pr, S).

BRAZIL: Parahyba: lake near Campina Grande, *S. Wright 2017*, July 1934 (D), 1573, Nov. 1934 (D), Açude Puxinanã, 1565, 1568, 1574, 1592, 1985, 1998, 2000, 2019, Mar. 1934—Jan. 1935 (D), Açude Simão, 1572, 1608, 1967, 1999, Feb. 1934—Mar. 1935 (D), Açude Lapa, 1559, Jan. 1935 (D), Açude Baixo de Pão, 2041, Dec. 1933 (D), Açude Velho, 1558, 1561, 1567, 1570, 1573, 1587, 1589, 1606, 1992, 2004, May 1934—Mar. 1935 (D, F, L, N, S); Açude Linda Flor near Mojeiro de Baixo, *Wright 1562*, Nov. 1934 (D, Mi, N); Açude Esperança near Esperança.

Wright 1974, 2043, Dec. 1933 (D, S); açude near Serra Branca, Wright 1995, Apr. 1934 (D). Ceará: Lagôa Porangabuçu, Fortaleza, Drouet 1504, Dec. 1935 (D, N); Açude Cedro, Quixadá, Wright & P. Azevedo 1539, Aug. 1935 (D, F, Mi, N); Açude São Francisco near São Francisco, Wright, Nov. 1937 (D, F, N). Pará: in small bays, Rio Tapajóz, J. W. H. Trail 165 (TYPE of *Microcystis caerulea* Dickie, BM). ARGENTINA: Buenos Aires: Laguna Los Chilenos near Dufaur, Wright 2113, Jan. 1937 (D); Laguna Chascomus, Wright 2101, Nov. 1936 (D); Laguna Blanca Grande, Wright 2098, Jan. 1937 (D, F, L, N, S). San Luis: Laguna Tala, Wright 2111, Dec. 1936 (D); Laguna La China, Wright 2112, Dec. 1936 (D); Laguna Garcia, Wright 2096, Dec. 1936 (D).

PHILIPPINE ISLANDS: Pasig River, Manila, W. R. Shaw 347, Mar. 1909 (Ber, L, N, U), *E. Quisumbing* 9, 1929 (T). CAMBODIA: im Bien-ho [Toulé-Sap], O. Kundze, 1875 (N). INDIA: Bombay, in einem Bassin der 'Victoria-Garden', A. Hansgirg, Nov. 1895 (Hauck & Richt. Phyk. Univ. 748B, L, Min, N), Sept. (ISOTYPE of *Polycystis insignis* Beck, Krypt. Exs. Mus. Vindob. 227, N); Teichen bei Calcutta, S. Kurz 1756, Mai 1867 (Ber). CEYLON: W. Ferguson 276, 295 (L).

This is the common species of *Microcystis* which develops as copious water-blooms in lakes, ponds, and streams. Where sparsely represented in the plankton, there is often seen a predominance of spherical plants; to this form the name *M. flos-aquae* has been chronically misapplied in recent years. Wittrock's original description and type collection of *Polycystis flos-aquae* refer unmistakably to material of a heavy water-bloom in which the individual plants are agglutinated and almost or entirely confluent with each other.<sup>1</sup> The original specimens of *P. prasina* are similar to those of *P. flos-aquae* except in color of the masses. The type collection of *P. scripta* contains predominantly elongated and branched plants. The original collections of *Microcystis ichthyoblabe* Kütz. and *Polycystis viridis* A. Br. consist principally of plants with conspicuously delimited gelatin; in the latter, the plants are small and few-celled. Plants which are clathrate or which have depressions in their surfaces have in general been referred in the past to *Microcystis aeruginosa* (or *Clathrocystis aeruginosa*) as described by Henfrey. Original specimens of *M. aeruginosa* f. *occidentalis* Wm. R. Tayl., *M. caerulea* Dickie, *Polycystis insignis* Beck, *P. ochracea* Brand, and *Clathrocystis robusta* Clark have no distinctive features by which we can separate them from *Microcystis aeruginosa* Kütz. as treated here.

<sup>1</sup> Wittrock's original description (Wittr. & Nordst., Alg. exs. 298) reads: "[Polycystis]. thallo mucoso difformi, sublutescente-aeruginoso (colore thalli siccati vix mutato); familiis confertis, vix distinctis; cellulis globosis, corpore phycochromaceo structura verosimiliter eadem ac in *P. prasina*; diametro cellularum  $4\frac{1}{2}$ - $6\frac{1}{2}$   $\mu$ ." The forms indicated under the name *Microcystis flos-aquae* by Kirchner in Engler & Prantl, Naturl. Pflanzenfam. 1(1): 56 (1900), Forti in Sylloge Myxophyc. 86 (1907), and Geitler in Rabenh. Kryptogamen-Fl. 14: 138 (1930) differ considerably among themselves and each from that indicated by Wittrock.



### Nomina Excludenda

The following names are to be excluded from the group. Type and otherwise authenticated specimens are here referred to other genera of plants and animals.

*Anacystis amplivesiculata* Gardn., Mem. New York Bot. Gard. 7: 22 (1927)=GLOEOCAPSA SP.

*A. anomala* Gardn., ibid. 7: 26 (1927)=GLOEOCAPSA SP.

*A. compacta* Gardn., ibid. 7: 20 (1927)=GLOEOCAPSA SP.

*A. consociata* Gardn., ibid. 7: 25 (1927)=GLOEOCAPSA SP.

*A. cylindrica* Gardn., ibid. 7: 19 (1927)=GLOEOTHECE SP.

*A. distans* Gardn., ibid. 7: 21 (1927)=GLOEOCAPSA SP.

*A. elabens* Setch. & Gardn., Univ. Calif. Publ. Bot. 6: 455 (1918)  
APHANOTHECE ELABENS Drouet & Daily.<sup>1</sup>

*A. gigas* Gardn., Mem. New York Bot. Gard. 7: 15 (1927)=GLOEOCAPSA GIGAS West & West f.

*A. gloeocapsoides* Gardn., ibid. 7: 22 (1927)=GLOEOCAPSA SP.

*A. irregularis* Gardn., ibid. 7: 24 (1927)=GLOEOCAPSA SP.

*A. magnifica* Gardn., ibid. 7: 21 (1927)=GLOEOCAPSA GIGAS West & West f.

*A. marginata* Menegh., Consp. Fl. Eugan. 6 (1837)=APHANOTHECE SP.

*A. microsphaeria* Gardn., ibid. 7: 22 (1927)=GLOEOCAPSA SP.

*A. minutissima* Gardn., ibid. 7: 25 (1927)=GLOEOCAPSA SP.

*A. nidulans* Gardn., ibid. 7: 23 (1927)=GLOEOCAPSA SP.

*A. nigropurpurea* Gardn., ibid. 7: 18 (1927)=GLOEOCAPSA SP.

*A. nigroviolacea* Gardn., ibid. 7: 19 (1927)=GLOEOCAPSA SP.

<sup>1</sup> APHANOTHECE *elabens* (Bréb.), **comb. nov.** *Microhaloa elabens* Bréb. in Menegh. Monogr. Nostoch. Ital., 104 (1842). *Polycystis elabens* Kütz., Tab. Phyc. 1: 7 (1846). *Microcystis elabens* Kütz., ibid. 1: 6 (1846). *Anacystis elabens* Setch. & Gardn., Univ. Calif. Publ. Bot. 6: 455 (1918).—This species (if we can judge by labels and contents of Brébisson's collections) inhabits brackish waters of low salinity. The plants are small and somewhat reminiscent of species of *Microcystis* in the treatment above; however, the protoplasts are elongate as in other species of *Aphanothece*. The only adequate illustration which we have discovered is that in Desmazières, *Plantes Cryptogamiques de France*, No. 1952. *A. elabens* has been reported frequently under its various synonyms; most of the specimens thus labeled from Europe and America are to be interpreted as of species of *Aphanocapsa*, *Chlorogloea*, *Entophysalis*, and *Gloeocapsa*, and as *Microcystis aeruginosa* of this paper. Specimens of *Aphanothece elabens* seen: FRANCE: Falaise, Calvados, Brébisson (TYPE: L; isotype, Ber), Lenormand (Ber); in stagnis et turiosis circo Falaise, Brébisson (Rabenh. Alg. 2178, Ber, L, N, Ne); dans les flaques des tourbières d'un petit marais des environs de Falaise, Brébisson (Desmaz. Pl. Crypt. France 1952, N); Etang d'Aix près Marseille, herb. Bornet (F).

- Anacystis paludosa* Rabenh., Fl. Eur. Algar. 2: 52 (1865)=OPHRIDIUM SP.
- A. parasitica* Kütz., Tab. Phyc. 1: 7 (1846)=APHANOCAPSA SP.
- A. pulchra* Gardn., ibid. 7: 23 (1927)=GLOEOCAPSA SP.
- A. radiata* Gardn., ibid. 7: 26 (1927)=GLOEOCAPSA SP.
- A. radiata* var. *major* Gardn., loc. cit. (1927)=GLOEOTHECE SP.
- A. Reinboldii* Richt. in Hauck & Richt., Phyk. Univ. 9: 447 (1891)=APHANOCAPSA SP.
- A. Willei* Gardn., ibid. 7: 24 (1927)=GLOEOCAPSA SP.
- Microcystis austriaca* Kütz., Tab. Phyc. 1: 7 (1846)=EUGLENA SP.
- M. Donnellii* Wolle, Bull. Torr. Bot. Club 6: 282 (1879)=ciliate protozoa.
- M. elabens* Kütz., ibid. 1: 6 (1846)=APHANOTHECE ELABENS Drouet & Daily (see footnote 2 of this paper).
- M. firma* Schmidle, Engl. Bot. Jahrb. 32: 57 (1902)=Flagellata.
- M. ichthyoblabe* var. *violacea* Forti, Syll. Myxophyc. 89 (1907)=Nostocaceae (specimina manca)?
- M. littoralis* Forti, Syll. Myxophyc. 89 (1907)=APHANOTHECE SP.
- M. lobata* Dickie, Journ. Linn. Soc. Bot. 18: 128 (1880)=ANABAENA CIRCINALIS Born. & Flah.
- M. marginata* Kütz., Tab. Phyc. 1: 6 (1846)=APHANOTHECE SP.
- M. minor* Kütz., Tab. Phyc. 1: 11 (1846)=Flagellata.
- M. Noltii* Kütz., Linnaea 8: 342 (1833)=EUGLENA SP.
- M. olivacea* Kütz., Phyc. Gener. 170 (1843)=EUGLENA SP.
- M. paludosa* Forti, Syll. Myxophyc. 92 (1907)=OPHRIDIUM SP.
- M. parasitica* Kütz., Phyc. Gener. 170 (1843)=APHANOTHECE or CHLOROGLOEA SP.
- M. Paroliniana* Menegh., Monogr. Nostoch. Ital. 78 (1842)=GLOECYSTIS PAROLINIANA Rabenh.
- M. Reinboldii* Forti, ibid. 91 (1907)=APHANOCAPSA SP.
- M. rupestris* Kütz., Linnaea 8: 374 (1833)=GLOEOTHECE SP.
- M. umbrina* Kütz., ibid. 373 (1833)=Fungi.
- Clathrocystis roseo-persicina* Cohn, Beitr. Biol. Pflanzen 1: 157 (1875)=LAMPROCYSTIS ROSEO-PERSICINA Schroet.
- Microhaloa elabens* Bréb. in Menegh., Monogr. Nostoch. Ital. 104 (1842)=APHANOTHECE ELABENS Drouet & Daily (see footnote 2 of this paper).

*Microcystis firma* Kütz., Tab. Phyc. 1: 6 (1846)=Flagellata and APHANOCAPSA SP.

*M. pallida* Kütz., ibid. 1: 6 (1846)=Flagellata.

*M. rupestris* Kütz., Phyc. Gener. 169 (1843)=GLOEOTHECE SP.

*Polycystis elabens* Kütz., Tab. Phyc. 1: 7 (1845)=APHANOTHECE ELABENS Drouet & Daily (see footnote 2 of this paper).

*P. firma* Rabenh., Fl. Eur. Algar. 2: 53 (1865)=Flagellata and APHANOCAPSA SP.

*P. ichthyoblabe* b. *purpurascens* A. Br. in Rabenh., Krypt.-Fl. Sachsens 74 (1863)=Bacteria?

*P. littoralis* Hansg. in Foslie, Mar. Alg. Norway 169 (1890)=APHANOTHECE SP.

*P. marginata* Richt., Hedwigia 1885: 20 (1885)=APHANOTHECE SP.

*P. Packardii* Farl., Amer. Nat. 13: 703 (1879)=APHANOTHECE PACKARDII Setch.

*P. pallida* Farl., Mar. Alg. New Engl. 28 (1881)=Flagellata.

*P. violacea* Itzigs., Rabenh. Alg. Sachs. 31-32: 306 (1853)=Nostocaceae (specimina manca)?

### Nomina Inquirenda

The following names, for which no original material has been seen during this study, appear to be referable (according to descriptions and figures) to other groups of organisms than *Microcystis*.

*Anacystis brunnea* Wolle, Fresh-w. Alg. U. S., 329 (1887); *A. Grevillei* Kütz., Sp. Algar. 200 (1849).

*Clathrocystis elongata* Forti, Syll. Myxophyc. 96: (1907); *C. reticulata* Lemm., Bot. Centralbl. 76: 153 (1898).

*Microcystis angulosa* Kütz., Linnaea 8: 374 (1833); *M. atra* Kütz., ibid. 375 (1833); *M. atrovirens* Kütz., ibid. 374 (1833); *M. densa* G. S. West, Journ. of Bot. 47: 244 (1909); *M. deusta* Menegh., Monogr. Nostoch. Ital. 81 (1842); *M. fuscolutea* Forti, ibid. 92 (1907); *M. Grevillei* Kütz., ibid. 372 (1833); *M. mellea* Menegh., ibid. 83 (1842); *M. merismopedioides* Fritsch, Journ. Linn. Soc. Bot. 40: 333 (1912); *M. piscinalis* Forti, ibid. 90 (1907); *M. protogenita* Rabenh., Fl. Eur. Algar. 2: 31 (1865); *M. punctiformis* Kirchn., Alg. Schles. 256 (1878); *M. rosea* Kütz., ibid. 373 (1833); *M. sanguinea* Kütz., ibid. 372 (1833); *M. violacea* Kütz., ibid. 373 (1833).

*Microhaloa aurantiaca* Kütz., Phyc. Gener. 145 (1843); *M. botryoides* Kütz., ibid. 169 (1843); *M. iodes* Itzigs. in Rabenh., Fl.

Eur. Algar. 2: 53 (1865); *M. Pini-turionum* Bias., Di Alc. Algh. Microsc. 47; *M. protogenita* Bias., loc. cit.; *M. rosea* Kütz., Linnaea 8: 371 (1833).

*Polycystis fuscolutea* Hansg., Prodr. Algenfl. Böhmen 2: 145 (1892); *P. piscinalis* Brügg., Bündn. Alg. 249; *P. reticulata* Lemm., Bot. Centralbl. 76: 153 (1898).



# TROPICAL MARINE ALGAE OF THE ARTHUR SCHOTT HERBARIUM

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# TROPICAL MARINE ALGAE OF THE ARTHUR SCHOTT HERBARIUM

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It has been a peculiar pleasure to the writer to receive for study from time to time small groups of algal specimens collected by noted travellers primarily searching for land plants. These collections, sadly neglected since first brought back to our botanical institutions, if reported upon early would have added greatly to our knowledge of the marine algae of seas still barely touched; only now can the records they afford be published. The collection here in part reviewed is one of this sort, and one of the largest. Even at this late date many new records, and some actual extensions of range, are afforded by its study.

Arthur Carl Victor Schott (1814 1875) seems to have been an accomplished surveyor and naturalist (Sargent 1896, p. 18; Geiser 1936, p. 52; 1937, p. 332). During the survey of the Mexican United States Boundary he had charge of one of the field parties, and at the same time looked after a good deal of the botanical, zoological, and especially the geological collecting, for the Boundary Survey combined scientific exploration with its exacting professional demands on the surveyors. Apparently this was not Schott's only other accomplishment, for one notes in addition to references to his plants collected, that a number of topographic sketches and the colored prints of American Indian types published in the reports of the Survey are taken from his water-color sketches. The writer has no access to any biography or journals of Schott, so cannot attempt a résumé of his activities. By inspection of his specimens it appears that Schott collected in January and February 1853 at Indianola, Texas. On the 6th of the same month he also collected at Galveston, and during October, November, and December of that year, at the mouth of the Rio Grande (Boca del Rio Bravo del Norte of his old terminology). Again on the first of February 1854, and in 1855, he came to Indianola, securing an occasional specimen.

So far as they concern us, Schott next collected marine algae at Cartagena (approximately 10° 25' N. L.) in Colombia (politically Nueva Granada at that period), on the 5th and 8th of November 1857. Here he was again concerned with an engineering project, the interocean canal across Darien, but secured many algal speci-



mens. Early in November 1864, the 5th to 7th, he was in Havana, Cuba, and secured a number of specimens. Immediately thereafter he seems to have gone to Yucatan, for we have dates of the 15th November 1864 and December 1864 for Sisal. It appears (Standley 1930, p. 167) that he had been engaged by the Mexican government to make a geological survey of the peninsula. His botanical collections, particularly of vascular plants, were very extensive during this period. Early next year he did more work there between the 3rd and 13th of May. Specimens were collected on the 12th and 13th of May 1865 at Celestum also, overlapping the dates for Sisal, but the algal specimens attributed to Celestum for these dates are the more numerous. Celestum and Progreso are about 25 miles apart, air-line measure, and slightly farther by sea; Sisal (about 21° N. L.) is somewhat nearer Progreso, but like the others on a long sandy island which lies off that part of the Mexican coast, separated by a narrow channel, the Rio Grande de Lagartos, from the mainland. Off shore lies the great Campeche Bank, whence algal specimens were secured by Liebmann and described as new by J. G. Agardh (1847).

There are a few specimens cited in this paper from the above stations with other dates; possibly these are quite correctly labelled, but one feels a little hesitancy about accepting them, for fear some error has been made. Schott's specimens were numbered at some time after the labels were originally written, and there seems to be no logical sequence in relation to places or dates, which would have helped to confirm the data. The herbarium accession numbers, also, falling into more than one series, bear no relation to the others. It is not certain that all algal items collected by Schott at these places have come before the writer; in an earlier paper he (Taylor 1935, p. 124) published on six Schott algae in the collections of the British Museum (Natural History) some of which had numbers not represented in the Field Museum material; how many more were dispersed in the collections the writer cannot say.

It seems that Schott had hoped to have his collections worked up and published, but he died with this undone. It appears that he sent a set of specimens to W. H. Harvey at Dublin; just how wide a selection is not clear. At any rate a number of specimens of Schott's collecting on the Californian coast are cited in the "Nereis" (Harvey 1852-58), and Harvey returned a list of algae (chiefly from Cartagena) which Schott, with an introduction of his own, published in Lieut. Michler's report of the Darien survey (Harvey and Schott 1861). This small list did not cover all of the

Cartagena specimens, and he probably had far from a full series available. Other determinations on Schott's original labels may also derive from his correspondence with Harvey.

A letter written by C. F. Millspaugh at the time of the sale of Schott's specimens mentions a set sent to the Smithsonian Institution and another sent to Kew Herbarium, but not those at the British Museum. It appears that Schott intended to keep intact a complete set of algae for his own collections, and only sent off duplicates of those things of which he had an abundance. For a very modest sum Schott's widow sold his collections to Field Museum of Natural History in March 1897; they were large, of some thousands of specimens, not primarily algae. The algae were sent to W. G. Farlow of Cambridge for identification, and in Nov. 1898 he sent all of the specimens and the identifications back to Field Museum, but did not publish them. Apparently Farlow did not receive any of the material for his own herbarium. With these unpublished determinations the writer must in part disagree, and would at least have to modernize the nomenclature, so they are not cited. The published records in Harvey's list (Harvey and Schott 1861) are, however, incorporated. A number of additional specimens from these stations, for which no satisfactory determinations could be offered, exist in the collections of Field Museum.

The writer is greatly indebted to Major C. C. Gregg, Director of Field Museum of Natural History, and to Dr. Francis Drouet, Curator of Cryptogamic Botany, for the opportunity of studying this material and reporting upon it. Incorporated in this paper are a few records of specimens from other collections, but all of the specimens cited are in the Cryptogamic Herbarium of the Field Museum, and the italic number appended to each specimen record is the sheet number in that herbarium. For correspondence and information regarding the Schott specimens and other assistance the writer is indebted to Dr. Drouet, to Dr. W. R. Maxon of the U. S. National Herbarium, to Dr. D. H. Linder of the Farlow Herbarium, to Prof. S. W. Geiser of Southern Methodist University, Dr. C. L. Lundell of the University of Michigan Herbarium.

## CHLOROPHYCEAE

### Ulvaceae

ENTEROMORPHA LINGULATA J. Ag.--TEXAS: Indianola, Schott 17a, Jan. 1853, 980659; 9, 9a, 17b, Feb. 7, 1853, 980658, 979680, 979016; mouth of the Rio Bravo del Norte, Schott 18, no date,

38431, Schott 10, Oct. 1853, 38432, Schott 192, on sea beach, 1853, 980531.

ULVA LACTUCA L. TEXAS: Indianola, Schott 8, Feb. 1, 1853, 67099; Schott no number, 1855, 670100; Galveston, no collector given, no. 1, May 1878, 797077, 797078; CUBA, Habana, Schott 211, Nov. 6, 1864, 670092.

ULVA LACTUCA var. LATISSIMA (L.) DC.—COLOMBIA: Cartagena, Schott 52, Nov. 1857, 670096.

### Valoniaceae

CHAMAEDORIS PENICULUM (Ell. & Soland.) Kuntze.—COLOMBIA: Cartagena, Schott 11, Nov. 1857, 38435.

CLADOPHOROPSIS MEMBRANACEA (C. Ag.) Børg.—YUCATAN: Sisal, Schott 790, May 9, 1865, 977611.

### Cladophoraceae

CHAETOMORPHA MEDIA (C. Ag.) Kütz.—VENEZUELA: Puerto Cabello, Fr. Santiago 83, no date, 1007647.

RHIZOCLONIUM KOCHIANUM Kütz.?—TRINIDAD, B. W. I.: Cedros, on the ground close to the sea, W. E. Broadway 7018, Jan. 15, 1908, 676312.

CLADOPHORA FASCICULARIS (Mert.) Kütz.—COLOMBIA: Cartagena, Schott 16, 22, Nov. 1857, 977644, 980649; YUCATAN: Sisal, 370, 789a, May 9, 1865, 980724, 979502.

### Dasycladaceae

ACETABULARIA CRENULATA Lamx.—COLOMBIA: Puerto Colombia, attached to rocks near the water's edge, Fr. Elias 1402, Jan. 1937, 822424.

### Bryopsidaceae

BRYOPSIS PLUMOSA (Huds.) C. Ag.—YUCATAN: Sisal, Schott 371a, May 9, 1865, 977608; Schott 373 (Taylor 1935, p. 124).

### Caulerpaceae

CAULERPA ASHMEADII Harv.—YUCATAN: Sisal, Schott 209, May 9, 1865, 978988 (Taylor 1935, p. 124).

CAULERPA CRASSIFOLIA (C. Ag.) J. Ag. var. MEXICANA (Sond.) Weber-van Bosse.—YUCATAN: Sisal, Schott 368, no date, 980522 (Taylor 1935, p. 124).

CAULERPA CUPRESSOIDES (Vahl) C. Ag. YUCATAN: Chichankanab, G. F. Gaumer 1382, no date, 980529.

CAULERPA CUPRESSOIDES var. MAMILLOSA (Mont.) Weber-van Bosse f. NUDA Weber-van Bosse.—YUCATAN: Sisal, Schott 277b, May 9, 1865, 980520.

CAULERPA CUPRESSOIDES var. TURNERI Weber-van Bosse.—YUCATAN: Progreso, Schott 277a, Apr. 5, 1865, 980594; Sisal, Schott 277, May 9, 1865, 979684.

CAULERPA PASPALOIDES (Bory) Grev. var. WURDEMANNII Weber-van Bosse.—YUCATAN: Progreso, Schott 345a, Apr. 5, 1865, 40209; Sisal, Schott 345, May 9, 1865, 980750.

CAULERPA PROLIFERA (Forssk.) Lamx.—YUCATAN: Progreso, Schott 334, Apr. 1865 (Taylor 1935, p. 124); Sisal, Schott 344a, May 1865, 980521. Superbly developed plants, probably from shallow water, with blades to 1.5 cm. wide by 11.0 cm. long when dried.

CAULERPA RACEMOSA (Forssk.) J. Ag.—COLOMBIA: Cartagena, in shallow water, Schott 20, Nov. 1857, 979012 (Harvey and Schott 1861, p. 177, as *C. clavifera*); CUBA: Habana, Schott 213, Nov. 6, 1864, 967705.

CAULERPA SERTULARIOIDES (Gmel.) Howe f. BREVIPES (J. Ag.) Svedel.—COLOMBIA: Cartagena, Schott 27b, Nov. 8, 1857, 978999 (Harvey and Schott 1861, p. 177, as *C. plumaris* in part).

CAULERPA SERTULARIOIDES f. LONGIPES (C. Ag.) Coll.—COLOMBIA: Cartagena, Schott 27, Nov. 1857, 972767 (Harvey and Schott 1861, p. 177, as *C. plumaris* in part).

CAULERPA TAXIFOLIA (Vahl) C. Ag.—COLOMBIA: Puerto Colombia, Fr. Elias 1526, Jan. 1937, 881191; "Region of Barranquilla," Fr. Elias 1529, no date, 881176.

### Codiaceae

CODIUM ISTHMOCLADUM Vick.—YUCATAN: Sisal, A. Diaz (Schott 210), Dec. 1864, 670091; Celestum, Schott 374, May 12, 1865, 979504; COLOMBIA: Cartagena, Schott 36, Nov. 8, 1857, 979011 (Harvey and Schott 1861, p. 178 as *C. tomentosum*); Puerto Colombia, Fr. Elias 1400, Jan. 1936, 822413 (?).

HALIMEDA TRIDENS (Ell. & Soland.) Lamx.—YUCATAN: Sisal, Schott 786, no date, 977610.

HALIMEDA TUNA (Ell. & Soland.) Lamx. CUBA: Habana, Schott 945a, 1864, 979503; YUCATAN: Sisal, Schott 785, Nov. 10, 1865, 967764; Schott 786 (Taylor 1935, p. 124).

Near var. MINOR Vick.—CUBA: Habana, Schott 945, 1864, 979510.

Near var. PLATYDISCA (Decne.) Bart.—COLOMBIA: Cartagena, Schott 94, Nov. 1857, 980518 (Harvey and Schott 1861, p. 178 as *H. Tuna*).

PENCILLUS LAMOUROUXII Decne.—YUCATAN: Sisal, Schott 784, Nov. 10, 1865, 40575.

## PHAEOPHYCEAE

### Ectocarpaceae

ECTOCARPUS BREVIARTICULATUS J. Ag.—COLOMBIA: Cartagena, Schott 28, Nov. 5, 1857, 41192 (Harvey and Schott 1861, p. 177, referred to under the specific designation "octosporus"; Børgesen 1914, p. 173).

### Dictyotaceae

DICTYOPTERIS DELICATULA Lamx.—COLOMBIA: Cartagena, Schott 91a in part, Nov. 1857, 982222; CUBA: Habana, Schott 227 in part, Nov. 5, 1864, 670114; YUCATAN: Sisal, Schott 791, Dec. 1864, 40584; Schott 456a in part, May 7, 1865, 980596; PANAMA CANAL ZONE: Cristobal, Mrs. Geo. Artamanoff, no number, in part, Feb. 8, 1939, 968547.

DICTYOTA CERVICORNIS Kütz.—COLOMBIA: Cartagena, Schott 20, Nov. 1858, 979013; YUCATAN: Sisal, Schott 365, May 8, 1865, 980523 (perhaps Harvey and Schott 1861, p. 176 as *D. dichotoma* belongs here).

DICTYOTA CILIOLATA Kütz.—YUCATAN: Progreso, Schott 347, Apr. 5, 1865, 980499; Sisal, Schott 365 (Taylor 1935, p. 124).

DICTYOTA DIVARICATA Lamx.—COLOMBIA: Cartagena, Schott, no number, 1857, 980656.

PADINA SANCTAE-CRUCIS Børg.—COLOMBIA: Schott 26, Nov. 9, 1857, 979007; YUCATAN: Sisal, Schott 366, May 7, 1865, 977606.

PADINA VICKERSIAE Hoyt.—YUCATAN: Progreso, Schott 366b, Apr. 5, 1865, 980733.

ZONARIA VARIEGATA (Lamx.) Mert.—COLOMBIA: Cartagena, Schott 6, Nov. 1865, 114255 (Harvey and Schott 1861, p. 176 as *Z. lobata*).

## Fucaceae

SARGASSUM FILIPENDULA C. Ag.—TEXAS: Boca Chica del Rio Bravo del Norte, Schott 34, no date, 41378; CUBA: Habana, Schott 228, Nov. 1864, 670103; YUCATAN: Sisal, Schott 367, May 8, 1865, 978990; Chichankanab, G. F. Gaumer 1387, no date, 57316, 438292, 979541; Silam, Gaumer 2371, no date, 125940.

SARGASSUM HYSTRIX J. Ag. var. SPINULOSA (Kütz.) Grun. Plate I, figs. 1–3. Plant to 40 cm. tall, bushy, several slender stems eventually arising from the common (or conjoined?) holdfast. Stems freely alternately branched, the branches similar to the main axis, smooth throughout. Leaves scattered on the stems and branches, obtuse-oblong, below to 2.5 cm. long, 1.3 cm. wide, the base cuneate, the apex broadly rounded; midrib not conspicuous, nearly obsolete in the upper third of the leaf; margin crisped, irregularly and shallowly dentate, teeth aculeate tipped; cryptostomata numerous, very small, about 0.10–0.15 mm. diam., scattered over the leaf; leaves in the upper parts of the plant smaller, relatively broader, as 1.0 cm. long by 0.7 cm. wide, the cuneate base more prominent; further reduced at the bases of the receptacles. Vesicles scattered on the plant, solitary in the leaf axils or at the bases of branchlets or receptacles, 3–5 mm. diam., not apiculate, pedicel short, generally about 0.33–0.50 diam. of the vesicle in length, slender, not alate. Receptacles axillary to foliar bracts, 0.5–1.0 cm. long, one or two times alternately divided, or the bracts suppressed with the apparent result of an inflorescence 3–6 times alternately branched on its main axis, the chief divisions in turn once or twice further divided; ultimate segments nodulose, subcylindrical below, cervicorn to plane above with coarsely aculeate margin, fertile throughout. GRENADA, B. W. I.: St. Georges Harbor, floating, B. E. Dahlgren, without number, Feb. 22, 1922; BRAZIL: Urubú, Municipio de Fortaleza, Ceará, washed up on the beach, Drouet 1331a, July 27, 1935 (perhaps also Rio de Janeiro, Hassler Exped. 1084, earlier thought to be a form of *S. Filipendula*).

In addition to the Grenadine specimen, on which the description is based, the writer would assign to this variety one from Fortaleza in Brazil. This plant has closely similar conceptacles and vesicles, though the latter occasionally have slightly foliar margined pedicels and bladders; the leaves are relatively narrower in the basal parts of the plant, more coarsely aculeate-dentate, larger (to 15 mm. wide, 40 mm. long) and the midrib subpercurrent.

Furthermore, he has before him a specimen from the harbor of Rio de Janeiro which has similar leaves, perhaps even larger and more pronouncedly aculeate-dentate, certain identification being withheld because of the sterility of the specimens.

In our Caribbean flora among the certainly known *Sargassa* only *S. platycarpum* has flat receptacles, which are laterally moderately dentate; the leaves show a single row of exceptionally large cryptostomata on each side of the midrib. Of the same flora *S. Hystrix* has terete-compressed cylindrical to obconic receptacles which are dentate, but not as spectacularly so as the present plant. The leaves of the common Florida phase of this species show no cryptostomata, or reduced ones, and tend to be more nearly entire; it is recognized as the var. *buxifolium* (Chauv.) J. Ag. The writer has compared<sup>1</sup> his specimens with a photograph of a specimen of *S. Hystrix* in Herb. J. Agardh, no. 2463, from Campeche Bank, leg. Liebmann, and notes that this authentic specimen has leaves strongly tapered toward each end, and the receptacles much more crowded. However, Kützing (Tab. Phyc. 11: pl. 4611 as *Carpacanthus spinulosus*) had a plant from the West Indies very like the present, though the spines on the receptacles were more divaricate. Børgesen (1914, p. 221) doubted if this was specifically the same as *S. Hystrix*, though DeToni (1895, p. 53) so accepted it. For the present and until more material is available it seems best to accept Grunow's (1915, p. 399) rating as a variety, with the amplified description to emphasize its peculiarities.

SARGASSUM FLUITANS Børg. TEXAS: Boca del Rio Bravo del Norte, on the sea beach, Schott 187 in part, Nov., Dec. 1853, 670115; CUBA: Moriano, Habana, driven ashore by a storm, H. A. van Hermann 455, 1. 8. 1905, 183181; PANAMA CANAL ZONE: Cristobal, Mrs. Geo. Artamanoff, no number, Feb. 8, 1939, 967412.

SARGASSUM NATANS (L.) J. Meyen.- TEXAS: Boca del Rio Bravo del Norte, on the beach, Schott 189 in part, Nov., Dec. 1853, 670115; GULF STREAM in the Atlantic: Schott 59, Oct. 1857, 670113; CUBA: Habana, A. Marnitz (herb. Schott, no number), no date, 670105.

SARGASSUM POLYCERATIUM Mont.—CUBA: Habana, Schott 227, Nov. 5, 1864, 670114; PANAMA CANAL ZONE: Cristobal, Mrs. Geo. Artamanoff, Feb. 8, 1939, 968547.

<sup>1</sup> The writer is greatly indebted to Dr. Eric Hultén, the Director of the Herbarium, University of Lund, and to Professor Harald Kylin, for the opportunity of examining the algae in the Agardhian Herbarium in 1937.

SARGASSUM VULGARE C. Ag.- COLOMBIA: Puerto Colombia, Fr. Elias 1528, Jan. 1937, 881165; VENEZUELA: Macuto, D. F., along the beach, H. Pittier 13044, no date, 615258.

TURBINARIA TURBINATA (L.) Kütz.- COLOMBIA: Cartagena, Schott 8, Nov. 1857, 114250 (Harvey and Schott 1861, p. 176).

## RHODOPHYCEAE

### Chaetangiaceae

GALAXAURA MARGINATA (Ell. & Soland.) Lamx.—CUBA: Habana, Schott 952, 1864, 980504.

GALAXAURA OBLONGATA (Ell. & Soland.) Lamx. CUBA: Habana, Schott 948, Nov. 6, 1864, 980537.

GALAXAURA RUGOSA (Soland.) Lamx.—CUBA: Habana, Schott 948 in part, Nov. 6, 1864, 980537.

### Gelidiaceae

GELIDIUM PUSILLUM (Stackh.) LeJol.- COLOMBIA: Cartagena, on rocks near tide line, Schott 24, Nov. 6, 1857, 977646.

### Corallinaceae

CORALLINA CUBENSIS (Mont.) Kütz.—CUBA: Habana, Schott 227 in part, Nov. 5, 1864, 670114; YUCATAN: Sisal, Schott 454 in part May 7, 1864, 977634; Schott 424, May 1865, 982245; Schott 367 in part, May 8, 1865, 978990; Progreso, Schott 424a, Apr. 5, 1864, 982247; Celestum, Schott 378a, in part, May 13, 1865, 982241.

CORALLINA SUBULATA Ell. & Soland. -COLOMBIA: Cartagena, Schott 9b in part, 91, 91a in part, Nov. 1857, 980516, 982234, 982222; CUBA: Habana, Schott, no number, Nov. 5, 1864, 98223; YUCATAN: Sisal, Schott 424b, May 1865, 982235.

JANIA CAPILLACEA Harv.—CUBA: Habana, Schott, no number, in part, Nov. 5, 1864, 982223.

### Grateloupiaceae

CRYPTONEMIA CRENULATA J. Ag.—COLOMBIA: Cartagena, Schott 83, Nov. 1857, 980816.

CRYPTONEMIA LUXURIANS (Mert.) J. Ag.—COLOMBIA: Cartagena, on corals in the harbor, Schott, no number, Nov. 1857, 982226.

HALYMENIA FLORESIA (Clem.) C. Ag.—COLOMBIA: Cartagena, Schott 7, Nov. 1857, 982244 (Harvey and Schott 1861, p. 177).



GRATELOUPIA CUNEIFOLIA J. Ag.—VENEZUELA: Puerto Cabello, Fr. Santiago 84, no date, 1007668.

### Solieriaceae

AGARDHIELLA TENERA (J. Ag.) Schmitz. GULF OF MEXICO: Schott 198, 1853, 977594; TEXAS: on the beach, Boca del Rio Bravo del Norte, Schott 190, Nov. 1853, 979282; Indianola, Schott, no number, 1855, 982267; COLOMBIA: Schott 82, Nov. 8, 1857, 980744; YUCATAN: Sisal, Schott 444, May 9, 1865, 980535.

### Rhodophyllidaceae

EUCHEUMA ACANTHOCADUM (Harv.) J. Ag.—GULF OF MEXICO: Schott 187 in part, 1853, 978975.

EUCHEUMA ISIFORME (C. Ag.) J. Ag.—YUCATAN: Sisal, Schott 222a, Nov. 11, 1864, 978985; A. Diaz, herb. Schott 221, 222, 223, Dec. 1864, 978976, 978980, 980743; Schott 225 Dec. 1864, 978983; Schott 441b, May 10, 1865, 978987; Schott 441a, May 1865, 977589; Schott 437, Nov. 9, 1865, 980539; Schott 441, Nov. 10, 1865, 978989; Progreso, Schott 439, Apr. 4, 1865, 979022; Schott 279, 281, Apr. 5, 1865, 978984, 978986.

WURDEMANNIA MINIATA (Draparn.) Feldm. & Hamel.—CUBA: Habana, Schott 231, Nov. 5, 1864, 977598.

### Hypneaceae

HYPNEA CERVICORNIS J. Ag.—COLOMBIA: Cartagena, Schott 38, 47 (Harvey and Schott 1861, p. 177, as *H. cornuta*), 74, Nov. 1857, 980730, 977642, 977631; Schott 87, Nov. 8, 1857, 977592; YUCATAN: Progreso, Schott 453, Apr. 5, 1865, 980533; Sisal, Schott 454, May 7, 1865, 977634.

HYPNEA MUSCIFORMIS (Wulf.) Lamx.—TEXAS: Indianola, Schott, no number, Feb. 1, 1854, 977640; COLOMBIA: Cartagena, Schott, no number, no date, 980725; Schott 14, Nov. 1857, 977593; Schott 9b, 43, 88, all in lesser part, Nov. 1857, 980516, 980718, 980729; Schott 87, in lesser part, Nov. 8, 1857; Puerto Colombia, Fr. Elias 1530, Jan. 1937, 881162; CUBA: Habana, Schott 212, in lesser part, Nov. 7, 1864, 980527; YUCATAN: Progreso, Schott 346a, Apr. 5, 1865, 980647; Sisal, Schott 233, May 7, 1865, 977590; Schott 373 in lesser part, May 9, 1865, 40257; Schott 465a in lesser part, 465, May 13, 1865, 977615.

HYPNEA SPINELLA (C. Ag.) Kütz.—COLOMBIA: Puerto Colombia, Fr. Elias, no. 1527, Jan. 1937, 881177.

## Gracilariaceae

GRACILARIA ARMATA J. Ag.—COLOMBIA: Cartagena, Schott 34<sup>c</sup> in part, Nov. 1857, 980735; YUCATAN: Sisal, Schott 232, Nov. 15, 1864, 980728 (?); Schott 447b, May 9, 1865, 978982 (?); Progreso, the specimens somewhat more characteristic than those just mentioned, Schott 449, Apr. 3, 1865, 978977. Some of the specimens which Harvey and Schott (1861, p. 177) assigned to *G. caudata* may belong here.

GRACILARIA CERVICORNIS (Turn.) J. Ag.—COLOMBIA: Cartagena, Schott 5, Nov. 8, 1857, 980506 (Harvey and Schott 1861, p. 177 as *G. domingensis*); YUCATAN: Sisal, Schott 454a, May 7, 1865, 977599; Schott 456, May 8, 1865, 977602; Schott 447, May 12, 1865, 980502.

GRACILARIA COMPRESSA (C. Ag.) Grev.—GULF OF MEXICO: Schott 181, 1853, 978981; COLOMBIA: Cartagena, Schott 1, 4, 39, Nov. 1857, 968556, 977625, 977622; Schott 5, Nov. 8, 1857, 980653; Schott 49, Nov. 1858 (date?), 977637.

GRACILARIA CONFEROIDES (L.) Grev.—TEXAS: Schott, no number, Indianola, 1853, 977643; Schott, no numbers, Jan. 1853, 977618, 980745; Schott, no numbers, Feb. 1, 1853, 42610, 977624; Schott, no number, Feb. 7, 1853, 980540; Galveston, Schott, no number, Feb. 6, 1853, 979281; GULF OF MEXICO: Schott 187 in part, 1853, 978975; YUCATAN: Sisal, Schott 446, May 9, 1865, 979975.

GRACILARIA CONFEROIDES var. LONGISSIMA Harv.—COLOMBIA: Cartagena, Schott 21, Nov. 1857, 968558 (Harvey and Schott 1861, p. 177 as *G. confervoides*).

GRACILARIA CORNEA J. Ag.—COLOMBIA: Cartagena, Schott 2, 17, 17b, 17c, (these four by Harvey and Schott 1861, p. 177 as *G. caudata*), 84, 84a, Nov. 1857, 980736, 972768, 972766, 972765, 980525, 979681; Schott 25, Nov. 8, 1857, 980500 (Harvey and Schott 1861, p. 177, as *G. duraë*); Schott 42, Nov. 1858 (?), 980503 (Harvey and Schott, *do*).

GRACILARIA DAMAECORNIS J. Ag.—COLOMBIA: Cartagena, Schott 33, 34 in part, 39, 48, 49 (these last three, and others, Harvey and Schott 1861, p. 177 as *G. rangiferina*), 88, Nov. 1857, 980595, 980735, 977622, 980616, 977637, 980729.

GRACILARIA DOMINGENSIS Sond.—YUCATAN: Celestum, Schott 447 in part, May 13 1865, 979682. This name is used in the sense in which it was used by Collins, Phyc. Bor.-Amer. 790, which is not necessarily nomenclatorially correct.

GRACILARIA FEROX J. Ag.—COLOMBIA: Cartagena, Schott 15 (Harvey and Schott 1861, p. 177 as *G. domingensis*), 16 (Harvey and Schott *do.* as *Alsidium Schottii*), 38 (Harvey and Schott *do.* as *G. cervicornis*), Nov. 1857, 977601, 980542, 977600; CUBA: Habana, Schott 212, Nov. 7, 1864, 980527; YUCATAN: Sisal, Schott 456a, May 7, 1865, 980596.

GRACILARIA FOLIIFERA (Forssk.) Børg.—COLOMBIA: Cartagena, Schott 12, 18 (Harvey and Schott 1861, p. 177, as *G. multipartita*), Nov. 1857, 977623, 977636; Schott 86, Nov. 8, 1857, 977639 (Harvey and Schott *do.*); CUBA: Habana, Schott 236, Nov. 1864, 977603; Schott 218, Nov. 5, 1864, 977638; Schott 220, Nov. 6, 1864, 977630; YUCATAN: Sisal, Schott 445, May 9, 1865, 977629 (?).

GRACILARIA MAMILLARIS (Mont.) Howe.—COLOMBIA: Cartagena, Schott 9, 9a, 9b (Harvey and Schott 1861, p. 177 as *Rhodymenia Palmetta*), 91a, Nov. 1857, 980749, 980544, 979001, 980516, 982222.

### Champiaceae

CHYLOCLADIA OVALIS (Huds.) Hook. —COLOMBIA: Cartagena, Schott 53, Nov. 1857, 980747.

The single specimen preserved showed the characteristic fibrous basal portion and a half dozen coarse erect branches which reached 12 cm. in height. The branches were naked below, but above the vesicular branchlets were well developed, though not crowded. They became distinctively plurilocular, with 5 7 cask-shaped segments in the longest ones. The maximum length ranged to 12 17 mm.; the width was 2 mm. in the dried specimen. This plant had been reported from Brazil by Martens (Taylor 1931, p. 304) as *Gastroclonium ovale*; this appears to be the second American record.

### Ceramiaceae

CERAMIUM FASTIGIATUM Harv.—YUCATAN: Progreso, Schott 346, Apr. 5, 1865, 980530; Schott 346e, May 9, 1865, 979507.

CERAMIUM NITENS (C. Ag.) J. Ag.—COLOMBIA: Cartagena, on shells, Schott 451, no date, 982229.

CERAMIUM STRICTUM (Kütz.) Grev. & Harv.—TEXAS: Indianola, Schott 35, and without number, Jan. 1853, 982230, 982268; Schott 34, Feb. 1, 1853, 982252.

CENTROCERAS CLAVULATUM (C. Ag.) Mont.—TEXAS: Indianola, Schott 25, no date, 980816; Schott, no number, in minor part, Feb. 1, 1854, 977640; COLOMBIA: Cartagena, Schott 41, Nov. 1857, 982232;

CUBA: Habana, Schott 948 in minor part, Nov. 6, 1864, 980537; YUCATAN: Sisal, Schott 454 in minor part, May 7, 1864, 977634; Schott 423, in minor part, May 8, 1865, 977616; Schott 277, 277a, 346e, all in minor part, May 9, 1865, 979684, 980520, 979507; Progreso, Schott 346d, Apr. 5, 1865, 979506; Celestum, Schott 378a and without number, both in minor part, May 13, 1865, 982241, 980732; COLOMBIA: Puerto Colombia, Fr. Elias 1525, in minor part, Jan, 1837, 881174; PANAMA CANAL ZONE: Cristobal, Mrs. Geo. Artamanoff, no number, Feb. 8, 1939, 968564.

SPYRIDIA ACULEATA var. HYPNEOIDES J. Ag. - YUCATAN: Progreso, Schott 346a, 788, 277b, 373, all in minor part, Apr. 5, 1865, 980720, 980647, 980520, 40257; Sisal, Schott 420, 348f in minor part, May 8, 1865, 982228, 977641; Schott 346e, in minor part, May 9, 1865, 979507; Celestum, Schott without number, May 13, 1865, 980732.

SPYRIDIA FILAMENTOSA (Wulf.) Harv. - COLOMBIA: Cartagena, Schott 45, Nov. 8, 1857, 982226; YUCATAN: Sisal, Schott 787, May 8, 1865, 982225, Schott 370 in minor part, May 9, 1865, 980724.

### Dasyaceae

DASYA PEDICELLATA (C. Ag.) C. Ag. - TEXAS: Indianola, Schott 6, Jan. 1853, 980719.

### Rhodomelaceae

ACANTHOPHORA MUSCOIDES (L.) Bory. COLOMBIA: Puerto Colombia, Fr. Elias 1525, Jan. 1937, 881174.

ACANTHOPHORA SPICIFERA (Vahl) Børg. COLOMBIA: Cartagena, beach toward Boca Grande, Schott 35, Nov. 1857, 977619 (Harvey and Schott 1861, p. 177, as *A. antillarum*); YUCATAN: Sisal, Schott 423, May 8, 1865, 977616.

BRYOTHAMNION SEAFORTHII (Turn.) Kütz. - COLOMBIA: Cartagena, Schott 3 (Harvey and Schott 1861, p. 177, as *Alsidium Seaforthii*), 91 in minor part, Nov. 1857, 982221, 982234; YUCATAN: Sisal, Schott 423, May 8, 1865, 977616; Schott 418, May 9, 1865, 982243; Progreso, Schott 422, Apr. 5, 1865, 1013303; CUBA: Habana, Schott without number, Nov. 5, 1864, 982223.

BRYOTHAMNION TRIQUETRUM (Gmel.) Howe. - COLOMBIA: Cartagena, Schott 92 (Harvey and Schott 1861, p. 177, as *Alsidium triangulare*), 44 in minor part, Nov. 1857, 982298, 980742; Schott 37, Nov. 8, 1857, 1013302 (Harvey and Schott, *do.*); YUCATAN: Progreso, Schott 278, Apr. 5, 1865, 977620; G. F. Gaumer 2369, without date, 979002; Celestum, Schott 421, May 13, 1865, 982233; José Fout

(in Schott herbarium without number), no date, 980512; Chichankanab, G. F. Gaumer 1348, no date, 980539; CUBA: Habana, Schott 229 and without number, Nov. 5, 1864, 982249, 982223.

CHONDRIA ATROPURPUREA Harv.—COLOMBIA: Cartagena, Schott no number or date, 982246; YUCATAN: Sisal, Schott 419, May 9, 1865, 1013301.

DIGENIA SIMPLEX (Wulf.) C. Ag.—TEXAS: Indianola, Schott without number, Feb. 1, 1853, 1013286; YUCATAN: Celestum, Schott 378, 378a, May 13, 1865, 1013287, 982241.

DIPTEROSIPHONIA DENDRITICA (C. Ag.) Falkenb.—COLOMBIA: Cartagena, Schott 19, 91, 91a, and without number, in minor part, upon *Protokuetzingia Schottii*, *Corallina subulata*, etc., Nov. 1857, 980817, 982234, 982222, 1013299.

HERPOSIPHONIA TENELLA (C. Ag.) Ambrohn.—COLOMBIA: Cartagena, Schott 19, and without number, on *Protokuetzingia*, Nov. 1857, 980817, 1013299, both in minor part.

LAURENCIA CORALLOPSIS (Mont.) Howe.—CUBA: Habana, Schott 234, Nov. 1864, 1013288.

LAURENCIA GEMMIFERA Harv.—COLOMBIA: Cartagena, Schott without number or date, 1013294 (Harvey and Schott 1861, p. 177 as *L. paniculata* in part).

LAURENCIA OBTUSA (Huds.) Lamx.—YUCATAN: Progreso, Schott 230, 348, 348a, Apr. 5, 1865, 1013290, 1013291, 1013289; Sisal, Schott 348f, May 8, 1865, 977641.

LAURENCIA POITEI (Lamx.) Howe.—COLOMBIA: Cartagena, Schott 31, Nov. 1857, 980723 (Harvey and Schott 1861, p. 177 as *L. paniculata* in part); Schott 43, Nov. 1858, 980718 (Harvey and Schott, *do.*); CUBA: Habana, Schott 230 Nov. 5, 1864, 1013293.

LAURENCIA PAPILLOSA (Forssk.) Grev.—COLOMBIA: Cartagena, Schott 50, Nov. 1858, 980722 (Harvey and Schott 1861, p. 177).

POLYSIPHONIA RAMENTACEA Harv.—COLOMBIA: Cartagena, Schott, no number or date, 1013297.

**Protokuetzingia Schottii**, *sp. nov.* Planta fastigiata, stricta, axibus ramisque paullo alternato-divisis, ramulis oppositis et determinatis et ad apices incurvatis 2–3 in nodis praeexistentibus, trichoblastes deciduosas ferentibus, nodis 1–3 mm. inter se distantibus, cellulis pericentralibus 5, fastigiis omnibus corticatis. Spermatangia conico-ovoidea vel subcylindracea, curto-stipitata, in partibus posterioribus

ramulorum fertilum affixa. Plantae carpogoniales plus irregulariter fastigiatae, pericarpis sessilibus et in partibus exterioribus ramulorum dense uniseriatis.—COLOMBIA: Cartagena, Schott 19, Nov. 1857, 980817 (TYPE in Cryptogamic Herbarium, Field Museum), *idem* without collection number, 1013299. Plate II, fig. 4 8.

Plant bushy, nearly black when dry, to 18 cm. tall (or more?). Base a slightly lobed, moderately thick disk about 3 4 mm. diam. Axis somewhat flexuous, erect, about 1.7–2.0 mm. diam., sparingly alternately divided below, more closely divided above, the lesser branches essentially similar to the axes, which are hardly distinguishable in the upper third of the plant, the whole except near the base bearing paired determinate branchlets at intervals. Younger axes and branches about 0.5 mm. diam., straight or slightly curved at the tips, bearing immature branchlets which are generally alternate, seldom opposite, generally erect and strongly upwardly curved toward the acute tips. Determinate branchlets opposite, or solitary opposite an indeterminate branchlet, somewhat laterally placed with respect to the axial plane, simple or one or two times alternately branched, or with a few accessory branchlets arising at the base of that first formed. Determinate branchlets tapered, strongly curved, irregularly but generally upward, regularly placed at intervals of 1–3 mm., about 0.08–0.16 mm. diam., 1.0 1.15 mm. long, the apices with branched but deciduous trichoblasts. Spermatangial plants somewhat more symmetrically branched than the carpogonial, the branchlets longer, simpler and more erect. Spermatangia conic-oval to subcylindrical, 75 115  $\mu$  diam., 150 225  $\mu$  long, 3–5 (or more?) attached on short stalks on the back of a fertile determinate branchlet. Carpogonial plants somewhat more spreading and irregularly branched in the upper part of the plant. Fertile determinate branchlets commonly larger than those on sterile or spermatangial plants, often to 3 mm. long, to 0.16 0.24 mm. diam., strongly circinately curved upward, the pericarps crowded in a row on the outer side of the branchlet, sessile, rounded-conical to ovate, with the apex occasionally slightly pointed, generally (immature?) 45–80  $\mu$  tall and about as broad at the base, occasionally to 230–260  $\mu$  diam.

Harvey and Farlow in their annotations would have related these specimens to *Rytiphloea pinastroides*, or its var. *episcopalis*, now *Halopithys pinastroides* (DeToni 1903, p. 1081), not to *R. tinctoria*, the residual species in the genus, which is clearly defined. Regarding Montagne's *Rhodomela pinastroides* var. *episcopalis* (Montagne 1840, p. 153, pl. 8, fig. 3) one may note that he states

that it only differs from the species in characters of the fruiting plant. The pericarps are figured as stalked and mucronate, though they are dorsally aligned on the branchlets. His description states that they are sessile, but the figures contradict this. It has not been easy to decide on a generic assignment for the proposed species. It has nothing in common with the habit of *H. pinastroides*, so far as the writer's several reference specimens indicate. In *H. pinastroides* the ultimate main axes are percurrent and densely clothed with suberect branchlets. In the present species branching is coarser, open and loose, without dominant axes. In *H. pinastroides* the pericarps are short stalked on the upper sides of the branchlets bearing them; in the present they are seriate, sessile and crowded on the curved backs of the branchlets. The presence of five pericentral cells would seem to rule out *Protokuetzingia*, and absence of a winged margin to the axis clearly eliminates most of the related genera. The choice is reduced to *Halopithys* or *Protokuetzingia*, with an alteration in the description of either genus necessary to include this plant. So many features of *Halopithys* are discordant that the writer chooses to place it in *Protokuetzingia*. To be sure, that was described with six pericentral cells—two large lateral cells, two smaller dorsally and two smaller ventrally placed, the lateral branchlets aligned with the ventral borders of the lateral series of cells. In the proposed *Protokuetzingia Schottii* there are five pericentral cells. The single dorsal one is large, and the lateral ones very similar. The ventral pair are a little smaller; the opposite lateral branchlets are ventral to the lateral cell series as before. The result is an axis slightly compressed on one face: that toward which the branchlets appear to be formed. In *Halopithys* the pericentral cells are of equal size, with the branchlets alternately on each side of the ventral cell row, on successive axial segments. The pairs of branchlets arise from the same axial siphon in our material, as in *Protokuetzingia*, not from successive segments. The aspect of our plant is very similar to *P. australasica*. However, the axis is less distinct throughout the plant, the branching also not clearly distichous. The tendency for the main branches to be erect and alternate (paired with a branchlet), and only occasionally opposite, is the reverse of conditions in *P. australasica*, where the spreading branches are generally opposite. The trichoblasts are much less evident; that may only be a matter of skillful preservation.

VIDALIA OBTUSILOBA (Mert.) J. Ag.—COLOMBIA: Cartagena, Schott 1, Nov, 1857, 980816 (Harvey and Schott 1861, p. 177 as *Rytiphloea obtusiloba*).

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## PLATES

PLATE I

*Sargassum Hystrix* var. *spinulosa* (Kütz.) Grun.

FIG. 1. Fertile branch with subtending leaves and receptacles. Grenada.  $\times 4.0$ .

FIG. 2. Sterile branch tip showing the form of the leaves and distribution of the cryptostomata. Grenada.  $\times 1.2$ .

FIG. 3. Fertile branch with subtending leaves and receptacles. Brazil.  $\times 2.6$ .



## PLATE II

*Protokuezingia Schottii*, sp. nov.

FIG. 4. Upper portion of a sterile branch system. The upper part of the right-hand branch shows the development of an unusual number of indeterminate branchlets.  $\times 3.0$ .

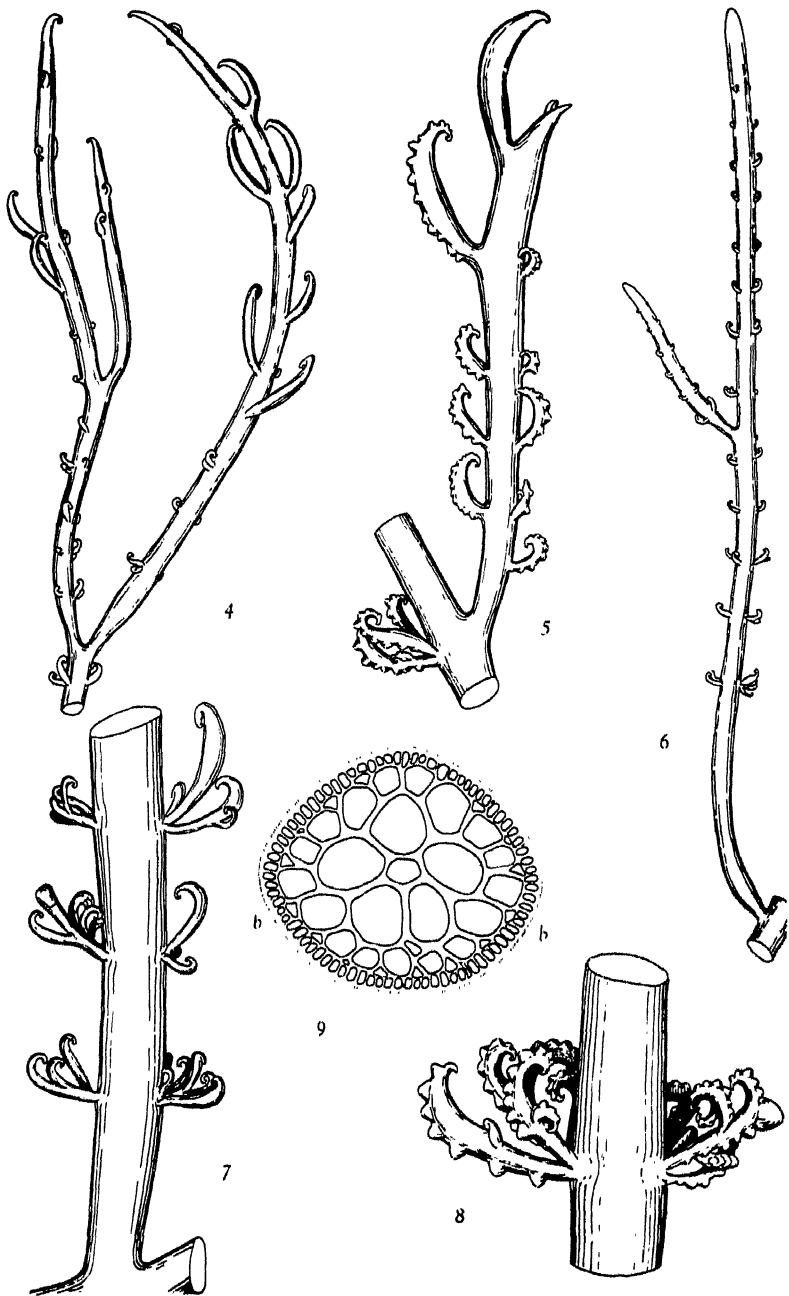
FIG. 5. Lateral branch upon a cystocarpic branch, showing the development of opposite, at first single, fertile branchlets.  $\times 11.0$ .

FIG. 6. Upper portion of a typically straight sterile branch, showing one indeterminate branchlet and many pairs of groups of determinate branchlets.  $\times 3.0$ .

FIG. 7. Lower portion of an old sterile branch, showing development at the nodes of additional determinate branchlets.  $\times 11.0$ .

FIG. 8. Single node from an old cystocarpic plant, showing development of additional, and branched, fertile branchlets.  $\times 15.0$ .

FIG. 9. Transverse section of a moderately old branch, showing pericentral cell arrangement. Branchlets arise in the positions marked "b".  $\times 32.0$ .





# THE FILAMENTOUS MYXOPHYCEAE OF JAMAICA

BY

FRANCIS DROUET

CURATOR OF CRYPTOGAMIC BOTANY



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# THE FILAMENTOUS MYXOPHYCEAE OF JAMAICA

FRANCIS DROUET

F. S. Collins in Proc. Amer. Acad. 37: 231-270 (1901) reviewed the earlier literature on the algae of Jamaica and interpreted the specimens known to him at that time. The myxophyceae included in his list were principally those collected by J. E. Humphrey and by C. E. Pease and E. Butler during the period 1891-1901.

Since that time many specimens by various collectors have accumulated in herbaria. The largest collection is that made by C. R. Orcutt during 1927-29, mostly of species inhabiting soil and rocks from many parts of the island. Some of Orcutt's specimens were sent to the British Museum (Natural History); most went to the United States National Museum and were distributed to various people and institutions through my personal herbarium and that of Professor Wm. Randolph Taylor during and prior to 1938. The late M. A. Howe visited Jamaica in 1906-07 and secured numerous marine specimens, especially from the north coast and from the vicinity of Kingston. I. F. Lewis collected in the eastern part of the island during trips in 1906 and 1908; many of his specimens were issued with published records by Collins, Holden & Setchell in *Phycotheca Boreali-americana*. Other botanical collectors, including F. S. Earle in 1902, L. M. Underwood in 1903, A. E. Wight in 1905-06, S. Maxwell in 1909, W. Harris in 1914, W. R. Maxon and E. P. Killip in 1920, and B. M. Davis in 1926, picked up specimens here and there.

Our knowledge of the inland aquatic algae of Jamaica has advanced little since 1901, as indicated by the absence of specimens of *Anabaena* in herbaria and by the paucity of species of *Nostoc*, *Phormidium*, *Oscillatoria*, and *Spirulina* listed here. Likewise many species of the soil and of brackish and salt water abundantly represented in herbaria from neighboring islands are conspicuously absent in Jamaican collections. On the other hand the collectors of the flora have claimed no more than secondary interest in the myxophyceae; they have picked up only random specimens during brief periods of work chiefly in the eastern quarter of the island. It may be surprising, therefore, that so large a number of species has been found in the material thus far accumulated. Speculation upon the relationship of the blue-green algal flora of Jamaica with that of other West Indian islands and of tropical America in general

may well be reserved until much more collecting has been done in the region.

Specimens cited below are to be found in the herbaria indicated by abbreviations as follows: BM, British Museum (Natural History); C, Herbarium of the University of California; D, Herbarium of Francis Drouet; F, Farlow Herbarium of Harvard University; FM, Cryptogamic Herbarium, Field Museum of Natural History; G, Herbarium of Goucher College, Baltimore; Mo, Herbarium of the Missouri Botanical Garden; N, Herbarium of the New York Botanical Garden; P, Herbarium of the University of Pennsylvania; S, Naturhistoriska Riksmuseet, Stockholm; T, Herbarium of Wm. Randolph Taylor; U, United States National Museum.

### Stigonemataceae

FISCHERELLA AMBIGUA (Born. & Flah.) Gom. Journ. de Bot. 9: 52 (1895). *Scytonema ambiguum* Kütz. ex Born. & Flah. Ann. Sci. Nat. VII Bot. 5: 100 (1887). *S. badium* Wolle ex Born. & Flah. (as sp. inquir.) *ibid.* 5: 111 (1887). *Phormidium interruptum* var. *rigidum* Gardn. Mem. N. Y. Bot. Gard. 7: 44 (1927). *Plectonema flexuosum* Gardn.<sup>1</sup> *ibid.* 7: 47 (1927).—On soil. One specimen, JAMAICA: Lewis, 1908 (C).

HAPALOSIPHON PUMILUS (Kütz.) Kirchn. ex Born. & Flah. *ibid.* 5: 61 (1887). *H. fontinalis* (Ag.) Born. Bull. Soc. Bot. France 36: 156 (1889). *H. brasiliensis* Borge Ark. f. Bot. 15 (13): 94 (1919). - The one collection, from fresh water, is that listed by Collins (see the first paragraph of this paper) as *H. fontinalis*. ST. MARY: on rocks in Wag Water river, Castleton, *Humphrey 397a*, Apr. 1893 (G, N).

MASTIGOCOLEUS TESTARUM Lagerh. ex Born. & Flah. *ibid.* 5: 54 (1887). *Scytonema conchophilum* Humphr. apud Coll. Proc. Amer. Acad. 37: 241 (1901).—Marine. The type (and only) collection of *S. conchophilum* contains old masses of *Mastigocoleus testarum* in which the numerous hormogonia have begun to grow and have burst out of the old and brown sheaths in many places, with the resulting appearance of scytonematoid branching. In some of the shells of the one collection *M. testarum* (as reported in Collins' list) is preserved in excellent condition. KINGSTON: in shells and bones, Navy Yard, *Humphrey*, Aug. 1997 (TYPE of *Scytonema conchophilum*, G; Phyc. Bor.-amer. LII, FM, T).

<sup>1</sup> The TYPE of *P. flexuosum* in the New York Botanical Garden (PUERTO RICO: on soil in the woods, Coamo Springs, N. Wille 272b, Jan. 1915) is an undeveloped mass of *Fischerella ambigua*.

## Nostocaceae

NOSTOC COMMUNE Vauch. ex Born. & Flah. Ann. Sci. Nat. VII Bot. 7: 203 (1888).—On wet soil and rocks. The Humphrey specimens cited are those referred to in Collins' list. PORTLAND: on damp earth, Port Antonio, *Humphrey*, July 1897 (FM, N). ST. THOMAS: Arntully, *Orcutt* 5601 (BM, D, F, N, S, U); Farm Hill, *Orcutt* 5463, 1928 (BM); Moy Hall, *Orcutt* 6328, Nov. 1928 (D, F, N, U). ST. ANDREW: on sandy soil, Constant Spring, *Humphrey* 365, Apr. 1893 (G, N). WESTMORELAND: Darliston, *Orcutt* 6227, 6228, 6231, 6235, Aug. 1928 (BM, D, F, N, S, U). JAMAICA: on earth, Green Castle, *Orcutt* 4555, Jan. 1928 (D, F, N, U).

NOSTOC VERRUCOSUM (L.) Vauch. ex Born. & Flah. *ibid.* 7: 216 (1888).—In freshwater streams. Included here is the material reported by Collins. PORTLAND: Stone Valley river, *Orcutt* 5844, 1928 (BM, D, F, N, S, U). ST. MARY: on rocks in Wag Water river, Castleton, *Humphrey*, Apr. 1893 (G).

NOSTOC PARMELIOIDES Kütz. ex Born. & Flah. *ibid.* 7: 219 (1888).—In freshwater streams. The one collection is the *N. microscopicum* of Collins' report. ST. ANDREW: on sides of and steps into the reservoir, Constant Spring, *Humphrey* 361, Apr. 1893 (G, N).

HORMOTHAMNION ENTEROMORPHOIDES Grun. in Born. & Flah. *ibid.* 7: 260 (1888).—In quiet marine waters. The specimens reported by Collins are included here. KINGSTON: on coral reef, Navy island, Kingston harbor, *Humphrey*, June 1897 (N). ST. ANN: in shallow water, St. Anns Bay, *Humphrey*, Mar. 1893 (Phyc. Bor.-amer. 56, D, FM, N, T). ST. JAMES: Montego Bay, *Davis*, 1926 (T). JAMAICA: *Humphrey* (Coll. N. Amer. Alg. 23, D, FM, N).

CYLINDROSPERMUM MUSCICOLA Kütz. ex Born. & Flah. *ibid.* 7: 254 (1888). *C. caeruleum* Dick. ex Born. & Flah. (as sp. inquir.) *ibid.* 7: 255 (1888).—On wet soil and in shallow fresh water. Specimens reported by Collins are here cited. ST. THOMAS: Moy Hall, *Orcutt* 7048, Nov. 1928 (D, F, N, U). ST. MARY: Castleton, *Humphrey* 364 (N); on sides of reservoir, Botanical Garden, Castleton, *Humphrey* 407, Apr. 1893 (N).

## Rivulariaceae

CALOTHRIX JULIANA (Menegh.) Born. & Flah. Ann. Sci. Nat. VII Bot. 3: 348 (1886). *Homoeothrix juliana* (Born. & Flah.) Kirchn. apud Geitl. Rabenh. Kryptogamenfl. 14: 575 (1932).—On rocks in freshwater streams. The one collection is reported by Collins. ST. ANN: Roaring river, *Humphrey* 324, Mar. 1893 (G, N).

*CALOTHRIX AERUGINEA* Thur. ex Born. & Flah. *ibid.* 3: 357 (1886).—On plants and other objects in marine and brackish water. The one collection is recorded as *C. confervicola* by Collins. PORTLAND: on several algae, Navy island, Port Antonio, *Humphrey* 236, Mar. 1893 (C, G, N).

*CALOTHRIX CONTARENII* (Zanard.) Born. & Flah. *ibid.* 3: 355 (1886).—On wood and rocks in intertidal zones and slightly above. The one collection reported by Collins, ST. MARY: on wreck on beach, Port Maria, *Humphrey*, Mar. 1893 (G).

*CALOTHRIX CRUSTACEA* Thur. ex Born. & Flah. *ibid.* 3: 359 (1886).—On rocks and other objects between tides and in the spray-zone above. KINGSTON: on wall of a littoral cavern, rocks below Fort Clarence, *Howe* 4654, 4655, Dec. 1906 (D).

*CALOTHRIX PILOSA* Harv. ex Born. & Flah. *ibid.* 3: 363 (1886). *Tildenia pilosa* Polj. Bull. Jard. Bot. Princip. URSS 27: 327 (1928). *T. dura* Polj. *ibid.* 27: 329 (1928).—Chiefly on rocks and sand between tide marks. PORTLAND: on *Bostrychia tenella*, Port Antonio, *Pease & Butler* (D, N). HANOVER: on rocks near Sandy bay, *Howe* 4394, Jan. 1907 (N). WESTMORELAND: on rocks, Robins bay, *Orcutt* 4682, Jan. 1928 (BM, D, F, N, S, U).

*DICHOTHRIX BORNETIANA* *Howe* Bull. Torr. Club 51: 357 (1924).—On rocks and shores between tide marks. HANOVER: on stones near Sandy bay, *Howe* 4940, Jan. 1907 (N).

*DICHOTHRIX FUCICOLA* (Kütz.) Born. & Flah. *ibid.* 3: 379 (1886).—Epiphytic on larger marine algae. One specimen cited here is in part the basis for Collins' record of *D. penicillata*. KINGSTON: on seawall, Gun Cay, *Howe* 4611, Dec. 1906 (D, N). JAMAICA: on *Dictyota dichotoma*, *Pease & Butler*, 1900 (N).

*DICHOTHRIX PENICILLATA* Zanard. ex Born. & Flah. *loc. cit.* (1886).—Epiphytic on larger marine algae. One collection here was listed by Collins. ST. MARY: on *Cymopolia barbata*, Port Maria, *Humphrey*, Mar. 1893 (Phyc. Bor.-amer. 62, FM, G, N). KINGSTON: Gun Cay, *Howe* 4612, Dec. 1906 (N). ST. JAMES: on *Digenia* on a littoral reef, Montego Bay, *Howe* 4772, Jan. 1907 (D, N).

*GLOEOTRICHIA NATANS* (Hedw.) Rabenh. ex Born. & Flah. *ibid.* 4: 369 (1886). *Rivularia natans* (Hedw.) Welw. ex Born. & Flah. (pro synonym.) *loc. cit.* (1886). *Calothrix scytonemicola* var. *brasiliensis* Borge Ark. f. Bot. 19 (17): 5 (1925). *Rivularia (Gloeotrichia) flagelliformis* Gardn. Mem. N. Y. Bot. Gard. 7: 71 (1927).—In quiet fresh water. The one collection is recorded in Collins' list. ST. MARY: on floating leaves, Botanic Garden, Castleton, *Humphrey* 413, Apr. 1893 (F, G, N).

## Scytonemataceae

SCYTONEMA ALATUM (Berk.) Borzi ex Born. & Flah. Ann. Sci. Nat. VII Bot. 5: 110 (1887). *Petalonema alatum* Berk. ex Born. & Flah. (pro synonym.) loc. cit. (1887).—On objects kept continuously wet with fresh water, particularly on cliffs. PORTLAND: Stone Valley river, *Orcutt* 5853, 1928 (D, F, N, U).

SCYTONEMA CRASSUM Näg. ex Born. & Flah. *ibid.* 5: 109 (1887).—On limestone and chalk wet during at least part of the year by seeping fresh water, less often on soil. PORTLAND: Chepstowe, *Orcutt* 4516, Jan. 1928 (D, U). ST. THOMAS: Arntully, *Orcutt* 5096, 1928 (BM, D, U); Farm Hill Works, *Orcutt* 5597, 5598a, May 1928 (BM, D, F, N, S, U).

SCYTONEMA VELUTINUM Rabenh. ex Born. & Flah. *ibid.* 5: 108 (1887).—On rocks and cliffs wet with fresh water at only certain seasons of the year. KINGSTON: on the Palisades, *Howe* 4561, Dec. 1906 (D, FM, N). ST. CATHERINE: on roadside bank, Bog Walk, *Howe*, Dec. 1906 (FM, N).

SCYTONEMA DENSUM (A. Br.) Born. ex Born. & Flah. *ibid.* 5: 109 (1887). *S. evanescens* Gardn. Mem. N. Y. Bot. Gard. 7: 71 (1927). *Petalonema densum* (Born. & Flah.) Mig. apud Geitl. Rabenh. Kryptogamenfl. 14: 793 (1932).—On soil and rocks continuously wet with fresh water. The one collection is recorded by Collins. PORTLAND: in turf, moist places, Port Antonio, *Humphrey* 421, Apr. 1893 (FM, G, N).

SCYTONEMA MYOCHROUS (Dillw.) Ag. ex Born. & Flah. *ibid.* 5: 104 (1887).—On rocks and soil wet at intervals with fresh water. ST. THOMAS: Arntully, *Orcutt* 2821, Sept. 1927 (BM); Farm Hill, *Orcutt* 5444a (BM).

SCYTONEMA FIGURATUM Ag. ex Born. & Flah. *ibid.* 5: 101 (1887). *S. mirabile* (Ag.) Born. Bull. Soc. Bot. France 36: 155 (1889), not Wolle.—On rocks and soil wet at least intermittently with fresh water. ST. THOMAS: Moy Hall, *Orcutt* 7050, Nov. 1928 (D, N, U); Farm Hill Works, *Orcutt* 5598, May 1928 (BM).

SCYTONEMA OCELLATUM Lyngb. ex Born. & Flah. *ibid.* 5: 95 (1887).—On soil, rocks, and trunks of trees. One collection cited below was recorded and distributed by Lagerheim in Wittr. & Nordst. Alg. exs. 28: 1322b (1896). ST. THOMAS: Farm Hill Works, *Orcutt* 5598b, May 1928 (D, F, N, U); Arntully, *Orcutt* 5618, 5794, 1928 (BM, D, F, N, S, U). ST. MARY: near Castleton Botanical Garden, *Underwood* 153a, Jan. 1903 (FM, N). ST. ANDREW: on

overhanging cliffs, *Lewis*, July 1906 (N), idem, Morces Gap (N); in cortice arboris ad Constant Spring, *G. Lagerheim*, Dec. 1892 (Wittr. & Nordst. Alg. exs. 1322b, FM, N). KINGSTON: on roadside bank near Hope Gardens, *Howe*, Dec. 1906 (D, FM, N); Hope, *Earle* 484, 1902 (D, N). ST. CATHERINE: walls of limestone cave, Troja, *Wight*, May 1909 (N). JAMAICA: Fern Hill, *Orcutt* 3427, 2537, Oct. 1927 (D, F, N, U); Ferry river, *Orcutt* 6276, 1928 (BM, D, F, N, U); Weireka, *Orcutt* 6267, 1928 (D, N, U); Geddy Hall, *Maxwell*, 1909 (BM); on stone walls. Resource, *Lewis*, 1908 (N).

SCYTONEMA VARIUM Kütz. ex Born. & Flah. *ibid.* 5: 97 (1887).—Subaerial on rocks and other objects in fresh water. The specimen reported as *S. Archangelii* by Collins belongs here. ST. MARY: on moist rocks by spring, Castleton, *Humphrey*, Apr. 1893 (G). JAMAICA: *Eggers* 3557 (FM).

SCYTONEMA HOFMANNII Ag. ex Born. & Flah. *ibid.* 5: 97 (1887).—Subaerial in fresh water, or aerial on rocks, soil, leaves, tree-trunks, etc. The specimens recorded as *S. javanicum* in Collins' list are placed here. PORTLAND: trail from Morces Gap to Vinegar Hill, *Maxon & Killip* 1299, Mar. 1920 (N, U); lower slopes of Blue Mountain peak, *Maxon & Killip* 1169, Mar. 1920 (N, U); road from Silver Hill Gap to Hardware Gap, *Maxon & Killip* 1244, Mar. 1920 (N, U). ST. THOMAS: on leaves of trees, Bath, *Humphrey* (Phyc. Bor.-amer. 1258, D, N, T). ST. MARY: on flower-pot in garden, Castleton, *Humphrey*, Apr. 1893 (G). ST. ANDREW: Morces Gap, *Lewis* (N); on rock near headwaters of Clyde river, *Lewis*, July 1906 (N). ST. CATHERINE: Troja, *Orcutt* 4638, Jan. 1928 (BM). JAMAICA: near Green river fording, *Harris* 10051, May 1914 (D, N).

SCYTONEMA JAVANICUM (Kütz.) Born. ex Born. & Flah. *ibid.* 5: 95 (1887). *S. hyalinum* Gardn. Univ. Calif. Publ. Bot. 14: 7 (1927). *S. guyanense* var. *epiphyllum* Gardn. N. Y. Acad. Sci. Sci. Surv. Porto Rico 8: 299 (1932).—On continuously wet leaves and trunks of trees. ST. MARY: Castleton, *Humphrey*, Apr. 1893 (G). JAMAICA: Glenburnie mountain, *Orcutt* 7726, Jan. 1929 (D, U).

SCYTONEMA GUYANENSE (Mont.) Born. & Flah. *ibid.* 5: 74 (1887). *S. mirabile* var. *majus* Gardn. Mem. N. Y. Bot. Gard. 7: 78 (1927). *S. guyanense* var. *minus* Gardn. *ibid.* 7: 79 (1927).—On rocks, soil, and other objects wet intermittently with fresh water. Here is placed the specimen termed *S. ocellatum* in Collins' list. PORTLAND: Spring Garden near Buff Bay, *Orcutt* 4769, Feb. 1928 (BM, D, F, N, S, U). ST. THOMAS: Moy Hall, *Orcutt* 5843, 1928 (D, U); Arntully, *Orcutt* 5108, Apr. 1928 (BM, D, F, N, S, U), idem on rocks, *Orcutt*

6907, Nov. 1928 (BM, D, N, S, U). ST. MARY: on bank, Stileman bay, *Orcutt* 4589, Jan. 1928 (D, U); on old palm stems, Castleton, *Humphrey*, Apr. 1893 (G). ST. ANDREW: Morces Gap, *Orcutt* 5564, 1928 (BM, D, F, N, U); near Constant Spring, *Orcutt* 6307, 6313 (BM). KINGSTON: Long mountain, *Orcutt* 6267, Aug. 1928 (BM). ST. CATHERINE: Great Salt pond, Cookson estate, *Orcutt* 6465, Sept. 1928 (D, N, U); Troja, *Orcutt* 4638, Jan. 1928 (D, N, U). WESTMORELAND: Darliston, *Orcutt* 6217, 1928 (BM, D, F, N, S, U). JAMAICA: Westphalia (Cedar Hurst), *Orcutt* 3757, Nov. 1927 (BM, D, U); Fern Hill, *Orcutt* 3418, 3547, 3609, Oct. 1927 (BM, D, F, N, S, U); *Lewis*, 1908 (C); on rock, *Orcutt* 3563 (BM).

SCYTONEMA MILLEI Born. ex Born. & Flah. *ibid.* 5: 93 (1887).—On soil and rocks. ST. ANDREW: Mavis Bank road, *Lewis*, June 1906 (Phyc. Bor.-amer. 1405, D, FM, N, T). JAMAICA: *Lewis*, Jan. 1908 (C; Phyc. Bor.-amer. 1557b, FM, N, T).

SCYTONEMA STUPOSUM Born. ex Born. & Flah. *ibid.* 5: 92 (1887). *S. caldarium* Setch. *Erythea* 7: 48 (1899). *S. azureum* Tild. *Amer. Alg.* 7: 630 (1909).—Subaerial on rocks and other objects in fresh water. Here are placed two collections reported in the Collins list as *S. crispum*. The material distributed by Collins, Holden & Setchell as *S. crispum* in Phyc. Bor.-amer. No. 60 is heterogeneous; in some sets only *S. cincinnatum* is to be found, in at least one other only *S. stuposum*. ST. MARY: in reservoir, Botanical Garden, Castleton, *Humphrey*, Apr. 1893 (Phyc. Bor.-amer. 60, T). ST. ANDREW: sides of trough, Constant Spring, *Humphrey*, Apr. 1893 (G); on mosses and rocks, *Lewis*, July 1906 (N). JAMAICA: in herb. F. Wolle (P).

SCYTONEMA CININNATUM (Kütz.) Thur. ex Born. & Flah. *ibid.* 5: 89 (1887). *S. crispum* (Ag.) Born. *Bull. Soc. Bot. France* 36: 157 (1889).—Floating in quiet fresh water. Part of the material reported by Collins as *S. crispum* is placed here. See the remarks under *S. stuposum* above. ST. MARY: in reservoir, Botanical Garden, Castleton, *Humphrey*, Apr. 1893 (Phyc. Bor.-amer. 60, FM, G). KINGSTON: in basin, *Humphrey*, Apr. 1893 (G).

HASSALLIA BYSSOIDEA (Berk.) Hass. ex Born. & Flah. *ibid.* 5: 116 (1887). *Scytonema* (*Petalonema*) *junipericola* Farl. in *Coll. Hold. & Setch. Phyc. Bor.-amer.* 16: 756 (1900). *Anabaena cupressaphila* Wolle ex Forti *Syll. Myxophyc.* 456 (1907). *Tolypothrix byssoides* (Born. & Flah.) Kirchn. *apud Forti ibid.* 561 (1907).—On rocks, soil, and trunks of trees wet intermittently with rainwater. Here are placed the specimens distributed by Collins, Holden &



Setchell as *S. ocellatum* in Phyc. Bor.-amer. 1559a, b, and as *S. Millei* in 1557a. PORTLAND: on steps of courthouse, Port Antonio, *Humphrey* 422, Apr. 1893 (N), *Humphrey* 419 (N). ST. THOMAS: on concrete foundation, Arntully, *Orcutt* 5108a, 6912, Apr. and Nov. 1928 (BM, D, N, U). ST. MARY: Grays inn, *Orcutt* 4088a, Dec. 1927 (D, U), idem 4115a, 4152 (BM); near Castleton Botanic Garden, *Underwood* 153, Jan. 1903 (N). ST. ANDREW: on trees (Phyc. Bor.-amer. 1559a, FM, N, T), on earth, Cinchona, *Lewis*, Jan. 1908 (Phyc. Bor.-amer. 1559b, FM, N, T); Mavis Bank road, *Lewis* 16, June 1906 (N); on rocks in cañon of the Cane river near Kingston, *Howe*, Dec. 1906 (FM, N). ST. CATHERINE: Troja, *Orcutt* 4666, 4667, Jan. 1928 (BM). ST. JAMES: on bark of tree root, Montego Bay, *Howe*, Jan. 1907 (N). JAMAICA: *Lewis*, Jan. 1908 (C, Phyc. Bor.-amer. 1557a, FM, N, T); *Humphrey* 405 (N).

### Oscillatoriaceae

PORPHYROSIPHON NOTARISII (Menegh.) Kütz. ex Gon. Ann. Sci. Nat. VII Bot. 15: 331 (1892).—On soil, rocks, and other objects intermittently wet with fresh water. See Drouet in Amer. Journ. Bot. 24: 601 (1937) and Field Mus. Bot. Ser. 20: 39 (1939) for synonymy of this species. PORTLAND: Port Antonio, *Wight*, 1909 (D, T); in the mountains along headwaters of Buff river, Pleasant Hill to Buff Bay, *Orcutt* 3793, Nov. 1927 (BM, D, F, N, S, U). ST. THOMAS: Arntully, *Orcutt* 2708, Aug. 1927 (D, F, N, U), 7021, Nov. 1928 (BM, D, F, N, S, U). ST. ANDREW: on rock, trail to Cinchona, *Orcutt* 5501, 1928 (BM, D, F, N, U). KINGSTON: roadside bank near Hope Gardens, *Howe*, Dec. 1906 (D, N). ST. MARY: with *Scytonema Hofmannii* on flowerpot in garden, Castleton, *Humphrey*, Apr. 1893 (G). TRELAWNEY: Rose Hill, *Earle*, 1902 (D, N). JAMAICA: *Lewis* (C; Phyc. Bor.-amer. 1555, FM, T).

PORPHYROSIPHON FUSCUS Gom. apud Frémy Bull. Mus. Hist. Nat. Paris 33: 115 (1927).—On soil wet occasionally by rains. KINGSTON: with *Schizothrix acuminata* on roadside bank near Hope Gardens, *Howe*, Dec. 1906 (FM).

*Schizothrix acuminata* (Gardn.) Drouet, **comb. nov.** *Microcoleus paludosus* var. *acuminatus* Gardn. Mem. N. Y. Bot. 7: 57, pl. ii, f. 5 (1927). Fila inter alias algas mixta, elongata, laciniata, pseudoramosa, ramis inferne intricatis, superne subparallelis aut in fasciculos repentis tortis; vaginis hyalinis demum pallide roseis vel fusco-roseis, apice hyalinis et acuminatis, firmis, solidis, plus minusve erosis, non aut vix lamellosis, chlorozincico iodurato laete caerules-

centibus; trichomatibus pallide aerugineis, intra vaginas inferne numerosis, superne solitariis vel paucis, parallelis, ad genicula non constrictis, 4–7  $\mu$  crassis; articulis diametro trichomatis vulgo longioribus, subquadratis usque ad duplo longioribus, protoplasmate inconspicue granuloso; cellula apicali acutissime conica, haud capitata.—Growing on soil, rocks, and other objects often wet with rainwater, usually in mats with other algae. The species is placed in Gomont's Section *Chromosiphon* near *S. purpurascens*. Its distribution as known to me is as follows. PUERTO RICO: on a wall at Fort San Cristobal, *N. Wille 2013a*, 1915 (TYPE, N). JAMAICA: KINGSTON: on roadside bank near Hope Gardens, *Howe*, Dec. 1906 (FM, N). SONORA: on banks by road to Tastiota southwest of Villa de Seris, *Drouet & Richards 2819a*, Nov. 1939 (FM).

SCHIZOTHRIX MUELLERI Näg. ex Gom. Ann. Sci. Nat. VII Bot. 15: 321 (1892). *Hydrocoleum Hieronymii* Richt. in Hauck & Richt. Phyk. Univ. 543 (1892).—On rocks and soil often wet with fresh water. PORTLAND: Mabess, *Lewis 20*, June 1906 (N).

SCHIZOTHRIX LAMYI Gom. ibid. 15: 323 (1892).—On soil occasionally wet by rains. ST. THOMAS: Arntully, *Orcutt 5722*, 1928 (BM, D, F, N, S, U).

SCHIZOTHRIX CHALYBEA (Kütz.) Gom. ibid. 15: 319 (1892).—On soil and rocks wet with rainwater. See Drouet in Bull. Torr. Club 64: 603 (1937) for notes on distribution. ST. ANDREW: on rocks, Bellevue, *Orcutt 6042, 6334*, 1938 (BM, D, F, N, S, U).

SCHIZOTHRIX VIOLACEA Gardn. Mem. N. Y. Bot. Gard. 7: 52 (1927); Drouet Bull. Torr. Club 64: 603, f. 2, 3 (1937).—On soil and rocks wet with rainwater. ST. THOMAS: Farm Hill Works, *Orcutt 5469*, 1928 (D, N, U); Arntully, *Orcutt 5097, 6807*, 1928 (BM, D, F, N, S, U).

SCHIZOTHRIX LACUSTRIS A. Br. ex Gom. ibid. 15: 301 (1892). *Inactis lacustris* (Gom.) Forti Syll. Myxophyc. 354 (1907).—On rocks almost constantly kept wet in fresh water. ST. ANN: with *Calothrix juliana* on stones in rapid stream, Roaring river, *Humphrey 328* (G, N).

SCHIZOTHRIX TINCTORIA (Ag.) Gom. ex Ann. Sci. Nat. VII Bot. 15: 303 (1892).—In fresh water. Here are placed the specimens recorded in Collins' list as *S. coriacea*. ST. MARY: in turf on sides of lily tank, Botanic Garden, Castleton, *Humphrey 409*, Apr. 1893 (C, F, FM, G, N).

SCHIZOTHRIX MEXICANA Gom. ibid. 15: 304 (1892). *Lyngbyopsis Willei* Gardn. Mem. N. Y. Bot. Gard. 7: 55 (1927).—In fresh water.

For distribution of this species see Drouet in Bull. Torr. Club 65: 286 (1938). The material cited here is that listed by Collins. ST. MARY: on rock in Wag Water river, Castleton, *Humphrey* 397, Apr. 1893 (F, G, N); with *Scytonema stuposum* in reservoir, Botanic Garden, Castleton, *Humphrey*, Apr. 1893 (Phyc. Bor.-amer. 60, T).

SCHIZOTHRIX FRIESII (Ag.) Gom. *ibid.* 15: 316 (1892). *Symplocastrum Friesii* (Gom.) Kirchn. apud Forti Syll. Myxophyc. 347 (1907). *Schizothrix purcellii* W. R. Tayl. Proc. Acad. Nat. Sci. Phila. 80: 91 (1928). *Symplocastrum Brittonae* Gardn. N. Y. Acad. Sci. Sci. Surv. Porto Rico 8: 287 (1932).—On rocks and soil often wet with fresh water. ST. ANDREW: slopes of Sir John peak, *Harris*, May 1914 (D, N).

HYDROCOLEUM COMOIDES (Harv.) Gom. *ibid.* 15: 325 (1892). On rocks between tide marks and in tide pools. The last specimen cited here was reported under this name by W. R. Taylor in Papers Mich. Acad. Sci. 17: 400 (1933). KINGSTON: on rocks, Drunkenmans Cay, *Howe* 4707, Dec. 1906 (D, N). ST. JAMES: on a littoral reef, Montego Bay, *Howe* 4769, 4771, Jan. 1907 (FM, N); on the seaward shore of the Bogue islands, Montego Bay, *Howe* 4821, Jan. 1907 (N). JAMAICA: Abingdon, *Orcutt* 6208b (T).

HYDROCOLEUM LYNGBYACEUM Kütz. ex Gom. *ibid.* 15: 337 (1892). *Oscillatoria additica* Gardn.<sup>1</sup> N. Y. Acad. Sci. Sci. Surv. Porto Rico 8: 270 (1932).—On other algae and rocks between tide marks. KINGSTON: on Lithophyllum, Gun Cay, *Howe* 4624, Dec. 1906 (D, N).

HYDROCOLEUM GLUTINOSUM (Ag.) Gom. *ibid.* 15: 339 (1892).—On rocks between tide marks. KINGSTON: Port Royal, *Orcutt* 6731, Oct. 1928 (T); Drunkenmans Cay, *Howe* 4710 4714, Dec. 1906 (N). ST. JAMES: northern shore of Montego Bay, *Howe* 4875, Jan. 1907 (N).

HYDROCOLEUM FLOCCOSUM (Hauck) Gom. *ibid.* 15: 341 (1892).—On rocks and other algae in marine waters. HANOVER: on rocks near Sandy bay, *Howe* 4975, Jan. 1907 (D, N).

SIROCOLEUM KURZII (Zell.) Gom. *ibid.* 15: 349 (1892). *Microcoleus Weeksii* Setch. & Gardn.<sup>2</sup> Univ. Calif. Publ. Bot. 6: 470 (1918).—On larger plants in marine waters. The specimen from

<sup>1</sup> The TYPE of *O. additica* in the New York Botanical Garden (PUERTO RICO: on Amphiroa, Salinas cove near Guanica harbor, *Howe* 7209, June 1915) consists of a mass of *Hydrocoleum lyngbyaceum* in which many of the trichomes have come out of the sheaths.

<sup>2</sup> The TYPE of *M. Weeksii* in the Herbarium of the University of California (CALIFORNIA: on Griffithsia near Pacific Grove, Monterey county, *Mrs. J. M. Weeks*, Feb. 1896) appears to be typical *Sirocoleum Kurzii*.

Jamaica cited here has trichomes smaller than are described for the species. HANOVER: near Sandy bay, *Howe* 4977, Jan. 1907 (N).

SIROCOLEUM GUYANENSE Kütz. ex Gom. *ibid.* 15: 348 (1892).—In brackish water and on mud between tide marks. JAMAICA: on *Bostrychia* (N).

MICROCOLEUS CHTHONOPLASTES (Fl. dan.) Thur. ex Gom. *ibid.* 15: 353 (1892).—On tidal flats and in brackish water. Material recorded in Collins' list as both *M. chthonoplastes* and *M. tenerrimus* is placed here. ST. ANN: in turf of algae, St. Anns Bay, *Humphrey*, Mar. 1893 (G); Runaway bay, *Orcutt* 6127, 1927–28 (T). JAMAICA: *Humphrey* 331 (N).

MICROCOLEUS VAGINATUS (Vauch.) Gom. *ibid.* 15: 355 (1892).—On soil intermittently wet by rains. Here is included the specimen reported under this name by Collins. ST. ANDREW: *Cinchona*, *Lewis* 8, 1906 (N). ST. CATHERINE: on moist mud, Rio Cobre, Bog Walk, *Humphrey*, Apr. 1893 (G).

MICROCOLEUS ACUTISSIMUS Gardn. Mem. N. Y. Bot. Gard. 7: 55 (1927); Drouet Amer. Journ. Bot. 24: 603, f. 3 (1937). *M. purpurens* Gardn. *ibid.* 7: 56 (1927).—On soil, rocks, etc. wet intermittently with rain water. ST. ANDREW: on moist rock in gorge of Cane river near Kingston, *Howe*, Dec. 1906 (FM, N).

PLECTONEMA WOLLEI Farl. ex Gom. Ann. Sci. Nat. VII Bot. 16: 98 (1892).—In fresh water. See Drouet in Field Mus. Bot. Ser. 20: 45 (1939). Specimens reported in the Collins list are included here. ST. THOMAS: in fresh water, Morant Bay, *Pease & Butler*, July 1894 (N). ST. ANN: in rapid current of Roaring river, *Humphrey*, Mar. 1893 (Phyc. Bor.-amer. 55c, FM, N, T).

PLECTONEMA TOMASINIANUM (Kütz.) Born. ex Gom. *ibid.* 99 (1892). *Lyngbya subconfervoides* Borge, Ark. f. Bot. 15 (13): 91 (1919).—In fresh water. PORTLAND: on stones in running water in gully, Stone Valley river, *Orcutt* 5881, 5883, 1928 (BM, D, F, N, S, U).

PLECTONEMA NOSTOCORUM Born. ex Gom. *ibid.* 16: 102 (1892).—Common in matrices and sheaths of most gelatinous algae. Among others may be cited one specimen, ST. THOMAS: with *Nostoc commune*, Moy Hall, *Orcutt* 6828, Nov. 1928 (D, F, N, U).

SYMPLOCA HYDNOIDES Kütz. ex Gom. *ibid.* 16: 106 (1892). *Phormidium pulvinatum* Coll. in Britt. & Millsp. Bahaman Fl. 621 (1920). *Symploca Howei* Gardn.<sup>1</sup> N.Y. Acad. Sci. Sci. Surv. Porto

<sup>1</sup> The TYPE of *S. Howei* in the New York Botanical Garden (PUERTO RICO: in shallow warm water, Cayo Don Luis near Pt. Montalva, *Howe* 7186, June 1915) is typical *S. hydroides*.

Rico 8: 283 (1932).—On other algae, rocks, etc. between tide marks. The one Jamaican specimen was recorded by Collins. JAMAICA: *Pease & Butler*, 1900 (N).

SYMPLOCA ATLANTICA Gom. *ibid.* 16: 109 (1892).—On rocks and other objects between and just above tide marks. HANOVER: near Sandy bay, *Howe 4933*, Jan. 1907 (D, N).

SYMPLOCA LAETE-VIRIDIS Gom. *ibid.* 16: 109 (1892). *Phormidium tenue* var. *marinum* Gardn.<sup>1</sup> N.Y. Acad. Sci. Sci. Surv. Porto Rico 8: 282 (1932).—On calcareous algae and on rocks between tide marks and just below. KINGSTON: in 3 dm. of water, in the harbor, *Howe 4472*, Dec. 1906 (D).

SYMPLOCA MUSCORUM (Ag.) Gom. *ibid.* 16: 110 (1892). *Phormidium Corium* var. *capitatum* Gardn. Univ. Calif. Publ. Bot. 14: 4 (1927). *P. interruptum* var. *capitatum* Gardn. Mem. N. Y. Bot. 7: 44 (1927).—Subaerial on soil, rocks, and mosses in fresh water. PORTLAND: trail from Morces Gap to Vinegar Hill, *Maxon & Killip 1317*, Mar. 1920 (F, FM, N). JAMAICA: on mosses, *Lewis*, July 1906 (N); G. river, *Lewis 21a*, July 1906 (N).

LYNGBYA SORDIDA (Zanard.) Gom. *ibid.* 16: 126 (1892). *L. rosea* W. R. Tayl. Carn. Inst. Wash. Papers Tortugas Lab. 25: 45 (1928). *L. sordida* f. *rosea* (W. R. Tayl.) Drouet in J. DeToni Diagn. Alg. Nov. 1 (Myxophyc. iii): 236 (1938).—Chiefly epiphytic on larger plants in marine waters. KINGSTON: Gun Cay near the harbor, *Howe 4610*, Dec. 1906 (D, N). ST. JAMES: on rocks, north shore of Montego Bay, *Howe 4854*, Jan. 1907 (D, N).

LYNGBYA AESTUARI (Mert.) Liebm. ex Gom. *ibid.* 16: 127 (1892). *L. ocreata* Gardn.<sup>2</sup> Mem. N. Y. Bot. Gard. 7: 39 (1927). *L. scytonematoides* Gardn. loc. cit. (1927).—On tidal flats and in brackish and fresh water. ST. CATHERINE: Fort Augusta, Kingston harbor, *Orcutt 6514*, Oct. 1928 (BM, D, F, S, U); Port Henderson, *Orcutt 6028*, 1928 (D, U).

LYNGBYA MAJUSCULA (Dillw.) Harv. ex Gom. *ibid.* 16: 131 (1892).—On rocks and other algae between tide marks. Included here are the specimens recorded in the Collins list. PORTLAND: Navy island, Port Antonio, *Humphrey 190*, Mar. 1893 (C, F, G, N); Port Antonio,

<sup>1</sup> The TYPE of *P. tenue* var. *marinum* in the New York Botanical Garden (PUERTO RICO: on sand rock, San Juan, *Howe 2112*, May 1903) is similar to the original collections of *Symploca laete-viridis* described by Gomont from Key West.

<sup>2</sup> The filaments referred to as *L. ocreata* and *L. scytonematoides* in the TYPE specimens in the New York Botanical Garden (PUERTO RICO: on damp earth by Playa, Fajardo, *N. Wille 710b and c*, Jan. 1915) appear to me to be peculiar growth-forms of *L. aestuarii*.

Wight, 1905-06 (S, T), *Pease & Butler*, July 1894 (F, N), July 1891 (N). KINGSTON: Gun Cay near the harbor, *Howe* 4619, Dec. 1906 (D, N); Drunkenmans Cay, *Howe* 4708 (D, N), 4729 (N), Dec. 1906. ST. JAMES: Montego Bay, *Davis*, 1926 (FM, T); in a Rhizophora association, Bogue islands, Montego Bay, *Howe* 4745, Jan. 1907 (C, D, F, N); seaward shore of Bogue islands, *Howe* 4821, Jan. 1907 (D). JAMAICA: *Pease*, 1892 (FM, N); floating in shallow water, *Pease & Butler*, July 1900 (Coll. N. Amer. Alg. 11, D, N).

LYNGBYA CONFEROIDES Ag. ex Gom. *ibid.* 16: 136 (1892). *L. confervoides* f. *violacea* Coll. Proc. Amer. Acad. 37: 240 (1901).—On rocks and wood between tide marks. Collins' type of the f. *violacea* and specimens reported as *L. aestuarii* belong here. PORTLAND: Manchioneal bay, *Pease & Butler*, July 1900 (TYPE of *L. confervoides* f. *violacea*, F), ST. ANDREW: north shore of Kingston harbor, *Howe* 4683, Dec. 1906 (F, N), 4681 (D, N). KINGSTON: on stones in harbor, *Humphrey* 384, Apr. 1893 (C, F, G, N); on Thalassia, Drunkenmans Cay, *Howe* 4725, Dec. 1906 (D, N); in the harbor, *J. E. Duerden*, May 1901 (N). ST. JAMES: northern shore of Montego Bay, *Howe* 4855, Jan. 1907 (D, N).

LYNGBYA PUTEALIS Mont. ex Gom. *ibid.* 16: 143 (1892).—In fresh water. The one specimen, recorded in the Collins list, [ST. THOMAS: Morant Bay,] *Pease & Butler* (N).

LYNGBYA VERSICOLOR (Wartm.) Gom. *ibid.* 16: 147 (1892). *Leptothrix tenax* Wolle Fresh Water Alg. U. S. 319 (1887). *Hypheothrix tenax* Wolle ex Forti Syll. Myxophyc. 329 (1907).—In fresh water. The one collection is that reported in the Collins list. KINGSTON: on sides of basin of a fountain, Marine Garden, *Humphrey*, Apr. 1893 (Phyc. Bor.-amer. 54b, FM, G, N).

PHORMIDIUM CROSBYANUM Tild. Amer. Alg. 7: 645 (1909). *P. Hendersonii* Howe Smiths. Misc. Coll. 68: 2 (1918). *P. angustissimum* var. *saxicola* Gardn. N. Y. Acad. Sci. Sci. Surv. Porto Rico 8: 279 (1932). Stratum viride, luteum, fuscum, aerugineum, griseum, vel roseolum, pulvinatum vel depresso-hemisphaericum, cartilagineum, plus minusve calcareum, filis minutis, ad basalem partem plantae intricatis, superne parallelis, flexilibus; vaginis arctis saepe diffluentibus, hyalinis, chlorozincico iodurato caerulescentibus; trichomatibus pallide aerugineis, 1-2  $\mu$  crassis, ad genicula non constrictis, ad apices non attenuatis; articulis diametro trichomatis usque ad duplo longioribus, protoplasmate haud granuloso; cellula apicali superne rotundata, non capitata.—In shallow tropical marine waters, forming cushions of leathery texture. As do those of *Lyngbya*

*sordida*, *Phormidium tinctorium*, and certain other species of myxophyceae, the trichomes shrivel in specimens which dry slowly; preserved material always gives the impression at first of being hopeless for critical observation. Howe's observation that the sheath-material in the TYPE of *P. Hendersonii* does not become blue when treated with chlor-zinc-iodine is an error. Among many specimens of *P. Crosbyanum* at hand the following have been selected to illustrate the species and its distribution. BAHAMA ISLANDS: in a tidal pond, West Caicos, *Howe 5701*, Dec. 1907 (FM, N). PUERTO RICO: on rocks, littoral, Santurce, *Howe 1929*, May 1903 (TYPE of *P. angustissimum* var. *saxicola* Gardn., N; isotype, D). GUADELOUPE: sur le sable, Pointe de Châteaux, *J. Feldmann 3760*, avril 1936 (T). TOBAGO: on Buccoo reef, *W. R. Taylor 517, 547*, Apr. 1939 (FM). HAITI: reef of coral, island off Anse à Margot (Bayeux) between Cap Haitien and Le Borgne, *H. H. Bartlett 17996*, June 1941 (FM). CUBA: on reef, Cayo Jutias, Pinar del Rio, *Henderson & Bartsch 103*, May 1914 (TYPE of *P. Hendersonii* Howe, U; isotypes, D, N). JAMAICA: Kingston: in 3 dm. of water in the harbor, *Howe 4472*, Dec. 1906 (Mo, N). St. James: near Montego Bay, *Howe 5021*, Jan. 1907 (N). PANAMA: on corals in high tide pools, southeast end of Caledonia harbor, Panama province, *W. R. Taylor 241*, Apr. 1939 (FM). HAWAIIAN ISLANDS: on rock shelf between tides, Wainae, Oahu, *J. E. Tilden* (N; isotype of *P. Crosbyanum* Tild. in Amer. Alg. 645, FM). PHILIPPINES: Lubang, Mindoro province, *H. S. Villaflores 13*, Sept. 1935 (FM); Boquete, vicinity of Puerto Galera, Mindoro, *H. H. Bartlett 14034* (FM).

PHORMIDIUM VALDERIANUM Gom. *ibid.* 16: 167 (1892). In fresh water. JAMAICA: 'Jamaica, Huss' (F).

PHORMIDIUM PAPYRACEUM (Ag.) Gom. *ibid.* 16: 173 (1892). *P. autumnale* var. *minus* Gardn. Mem. N. Y. Bot. Gard. 7: 45 (1927). —In fresh water. The one specimen is that reported by Hansgirg in Wittrock & Nordstedt, *Algae exsiccatae* 16: 776b (1886), as *Lyngbya* (*Phormidium*) *inundata*. ST. ANDREW: ad Gordon Town, *W. Joshua*, Oct. 1884 (Wittr. & Nordst. Alg. exs. 776b, FM).

PHORMIDIUM INUNDATUM Kütz. ex Gom. *ibid.* 16: 172 (1892). *P. purpurascens* var. *elegans* Drouet Bot. Gaz. 95: 696 (1934). —In fresh water. JAMAICA: with *P. uncinatum*, *Humphrey 426* (N).

PHORMIDIUM RETZII (Ag.) Gom. *ibid.* 16: 175 (1892). *P. leptodermum* var. *capitatum* Gardn. Mem. N. Y. Bot. Gard. 7: 43 (1927). —In fresh water. The one collection is the basis of the record in

Collins' list. ST. CATHERINE: in tufts on plants, Rio Cobre, Bog Walk, *Humphrey*, Apr. 1893 (F, G, N).

PHORMIDIUM UNCINATUM (Ag.) Gom. *ibid.* 16: 184 (1892).—In fresh water. PORTLAND: Stone Valley river, *Orcutt* 5851, 5863 (D, N, U). JAMAICA: *Humphrey* 426 (N).

PHORMIDIUM PENICILLATUM Gom. in Jadin Bull. Soc. Bot. France 40: clix (1893). *Symploca profunda* W. R. Tayl. Carn. Inst. Wash. Papers Tortugas Lab. 25: 47 (1928). *Oscillatoria maricola* Gardn. N. Y. Acad. Sci. Sci. Surv. Porto Rico 8: 270 (1932).—In quiet marine waters. See Drouet in Bull. Torr. Club 65: 286 (1938). PORTLAND: shaded shallow water, Blue Hole, *Wright*, May 1906 (D, F, N, S). Also to be referred here is the specimen from KINGSTON: on stones, Drunkenmans Cay, *Howe* 4701, Dec. 1906 (N).

OSCILLATORIA PRINCEPS Vauch. ex Gom. Ann. Sci. Nat. VII Bot. 16: 206 (1892). *O. princeps* f. *purpurea* Coll. in Coll. Hold. & Setch. Phyc. Bor.-amer. 16: 753 (1900). *O. obtusa* Gardn. Mem. N. Y. Bot. Gard. 7: 38 (1927). *Lyngbya gigantea* Lew. Zirk. & Patr. Journ. Mitch. Sci. Soc. 1933: 221 (1933).—In quiet fresh water. Specimens recorded in Collins' list as both *Oscillatoria princeps* and f. *purpurea* are included here. ST. THOMAS: Bath, *Pease & Butler*, July 1900 (TYPE of *O. princeps* f. *purpurea*, N; isotypes in Phyc. Bor.-amer. 753, D, FM, N, T, U). ST. ANN: in stream, St. Anns Bay, *Humphrey* 315, 315a, Mar. 1893 (F, G, N).

OSCILLATORIA PROBOSCIDEA Gom. *ibid.* 16: 209 (1892). *O. refringens* Gardn. Mem. N. Y. Bot. Gard. 7: 38 (1927).—In quiet fresh water. The specimens cited here are those of Collins' list. ST. MARY: in pool by Wag Water river, Castleton, *Humphrey* 401, Apr. 1893 (C, G, N); in stream from reservoir, Castleton, *Humphrey* 408, Apr. 1893 (C, FM, G, N).

OSCILLATORIA BONNEMAISONII Crouan ex Gom. *ibid.* 16: 215 (1892).—In brackish and almost marine water. KINGSTON: Drunkenmans Cay, *Howe* 4712, Dec. 1906 (D, N).

OSCILLATORIA TENUIS Ag. ex Gom. *ibid.* 16: 220 (1892).—In fresh water. The one specimen is that listed by Collins. ST. THOMAS: Bath, *Pease & Butler*, 1900 (N).

OSCILLATORIA FORMOSA Bory ex Gom. *ibid.* 16: 230 (1892).—In fresh water. The specimens reported as *O. formosa* and *O. anguina* in Collins' list are treated here. ST. MARY: in spring pool, Castleton, *Humphrey*, Apr. 1893 (G). ST. ANN: in still pool below fall, Roaring river, *Humphrey* 326, 326a, Mar. 1893 (C, F, G, N). JAMAICA: *Humphrey* (D), 412 (N).



SPIRULINA TENERRIMA Kütz. ex Gom. *ibid.* 16: 252 (1892). *S. socialis* Gardn.<sup>1</sup> N. Y. Acad. Sci. Sci. Surv. Porto Rico 8: 272 (1932).—In brackish and marine waters. ST. ANN: with *Microcoleus chthonoplastes*, Runaway bay, *Orcutt* 6127, 1927–28 (T). HANOVER: with *Hydrocoleum floccosum* on rocks near Sandy bay, *Howe* 4975, Jan. 1907 (D).

<sup>1</sup> The TYPE of *S. socialis* in the New York Botanical Garden (PUERTO RICO: Santurce, *Howe* 2162a, May 1903) appears to contain only typical *S. tenerrima*.





# STUDIES IN MYXOPHYCEAE. I.

BY

FRANCIS DROUET

CURATOR OF CRYPTOGAMIC BOTANY



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## STUDIES IN MYXOPHYCEAE. I.

FRANCIS DROUET

Specimens cited here are to be found in herbaria as indicated by the following abbreviations: C, Herbarium of the University of California; D, Herbarium of Francis Drouet; F, Farlow Herbarium of Harvard University; FM, Cryptogamic Herbarium, Field Museum of Natural History; N, Herbarium of the New York Botanical Garden; P, Herbarium of the University of Pennsylvania; T, Herbarium of William Randolph Taylor; U, United States National Herbarium.

**POLYCYSTIS glauca** (Wolle) Drouet & W. A. Daily, **comb. nov.** *Anacystis glauca* Wolle Bull. Torr. Club 6: 182. 1877. *Microcystis glauca* (Wolle) Drouet & Daily Field Mus. Bot. Ser. 20: 73. 1939.—This transfer is made necessary in the revival of the generic name *Polycystis* Kütz.; see Daily in Amer. Midl. Nat. vol. 27. 1942.

**APHANOCAPSA Farlowiana** Drouet & Daily, **sp. nov.** Plantae aquaticae, natantes, sphaericae vel ovoideae saepe tuberculatae, duriusculae, laete aerugineae, diametro 1–5 mm. crassae, gelatina hyalina et firma; cellulis sphaericis, diametro 2  $\mu$  ad 3  $\mu$  crassis, aerugineis, protoplasmate granuloso. Fig. 4.—Floating in shallow fresh water. This species has cells similar in size to those of *A. Richteriana* Hieron. but can be readily distinguished from the latter by the shape and consistency of the mass. It is named in honor of the late Professor William G. Farlow of Harvard University. Specimens seen, MASSACHUSETTS: floating in Oyster pond, Falmouth, R. N. Webster & Drouet 2156, July 1938 (TYPE in herb. F. Drouet; isotypes, C, F, N), idem, V. Trombetta & Drouet 2184, Sept. 1937 (D), idem, J. Bader, July 1938 (D); Hammonds pond, Newton, W. G. Farlow, Oct. 1890 (C, F, FM).

**PLEUROCAPSA Kernerii** (Hansg.) Drouet, **comb. nov.** *Xenococcus Kernerii* Hansg. Physiol. & Algal. Stud. 111. 1887. *X. acervatus* Setch. & Gardn. Univ. Calif. Publ. Bot. 6: 459. 1918. *Microcystis splendens* Hollenb. Bull. Torr. Club 66: 493. 1939. *M. ovalis* Hollenb. loc. cit. 1939. Plantae microscopicae, epiphyticae, aerugineae, primum pulvinatae demum hemisphaericae usque ad fere sphaericae, matrice gelatinosa hyalina vel luteola non aut vix lamellosa; cellulis aerugineis, sphaericis vel hemisphaericis vel polyhedroideis, vulgo ad 6  $\mu$  (raro usque ad 15  $\mu$ ) crassis, protoplasmate vix granuloso.—Epiphytic on other algae in fresh and

brackish water, rarely in marine water. Hansgirg's name *Xenococcus Kernerii* is here accepted on the basis of specimens interpreted thus by Ed. Bornet in the Farlow Herbarium. The plants in these specimens have cells separated by gelatinous material and are therefore quite different from those of species of *Xenococcus* and *Dermocarpa*, which possess distinct cell walls and do not produce a gelatinous matrix. The type material of *Xenococcus acervatus* Setch. & Gardn. distributed as *Pleurocapsa amethystea* var. *Schmidtii* Gardn. in Phyc. Bor.-amer. 1704 is excellent material of *Pleurocapsa Kernerii* as described above. The isotypic specimen of *Microcystis splendens* Hollenb. and *M. ovalis* Hollenb. in the Cryptogamic Herbarium of Field Museum consists of plants developed in culture which I can explain only as peculiar growths of this species under special conditions, some of the cells having become greatly enlarged and subsequently divided into numerous gonidia. Specimens seen, MAINE: on Rhodochorton and Sphacelaria, Eagle island, F. S. Collins 2113, July 1891 (F). MASSACHUSETTS: on Cladophora, Magnolia, W. G. Farlow, Sept. 1903 (F, FM); tide pool, Cohasset, Collins, Oct. 1901 (F; as *Xenococcus Kernerii* in Phyc. Bor.-amer. 952, FM); on Rhizoclonium, clay pit, Medford, Collins 5509, Sept. 1906 (F). NEW YORK: on *Cladophora expansa* in pool in salt marshes, Cold Spring Harbor, L. N. Johnson 1055, Aug. 1894 (F). CALIFORNIA: in pools in salt marsh near Berkeley, N. L. Gardner, Nov. 1905 (as *Pleurocapsa amethystea* var. *Schmidtii* in Phyc. Bor.-amer. 1704, isotype of *Xenococcus acervatus* Setch. & Gardn., FM); in old cultures of phaeophyceae, La Verne, G. J. Hollenberg 2179c, d, Dec. 1937 (isotype of *Microcystis splendens* Hollenb. and *M. ovalis* Hollenb., FM). SONORA: on back of a turtle in a pool, Unión, Hermosillo, Drouet & D. Richards 3020, Nov. 1939 (FM).

**PLEUROCAPSA Deeveyi** Drouet, sp. nov. Plantae microscopicae planctonicae multicellulares plus minusve sphaericae, usque ad 200  $\mu$  crassae, matrice gelatinosa hyalina demum luteola, arcta; cellulis aerugineis vel luteolis, polyhedroideis, raro hemisphaericis vel sphaericis, compactis, usque ad 7  $\mu$  crassis, protoplasmate haud granuloso.—Planktonic in brackish water. The habit of the plants reminds one forcibly of that of *Gomphosphaeria aponina* Kütz. and of *Botryococcus Braunii* Kütz., but the detailed structure is very different from that of either. It is possible that *Pleurocapsa Deeveyi* is a peculiar growth-form of *P. fuliginosa* Hauck, a species to be expected in such brackish water. The new species is named in honor of Dr. E. S. Deevey of the Rice Institute. Specimens seen,

TEXAS: La Sal Viejo, Willoughby county, *Deevey*, Jan. 1941 (TYPE in Cryptogamic Herbarium of Field Museum); La Sal del Rey, Hidalgo county, *Deevey*, Nov. 1941 (FM).

**CHROOCOCCUS sonorensis** Drouet & Daily, *sp. nov.* Plantae microscopicae 1-20-cellulares, irregulariter sphaericae vel ovoideae saepe lobatae, inter alias algas aquaticas crescentes, matrice gelatinosa hyalina homogenea non lamellosa, externe arcte delimitata vel diffuenti; cellulis aerugineis sphaericis vel hemisphaericis, distantibus, 3  $\mu$  usque ad 7  $\mu$  crassis, protoplasmate haud granuloso. Fig. 1.—Mixed with other algae in brackish water. The species is similar to the planktonic *C. limneticus* Lemm. of fresh water, but the plants are smaller and often lobate, and the cells seldom remain hemispherical for a long period as do those of *C. limneticus*. Specimens seen, SONORA: in pools of brackish water at the beach 4 km. east of Guaymas, *Drouet & D. Richards* 3296 (FM), 3298 (TYPE in Cryptogamic Herbarium of Field Museum), Dec. 1939.

**CHROOCOCCUS Prescottii** Drouet & Daily, *sp. nov.* Plantae microscopicae praecipuius cubicae, haud raro polydehroideae vel plus minusve sphaericae, 1-32-cellulares, laete aeruginosae, inter alias algas aquaticas crescentes, matrice gelatinosa hyalina homogenea vel obscure lamellosa, externe arcte delimitata vel diffuenti; cellulis aerugineis, sphaericis vel fere hemisphaericis, 4  $\mu$  usque ad 7  $\mu$  crassis, protoplasmate homoganeo vel sparse tenui-grnuloso. Fig. 2.—In shallow fresh water. This is the organism referred to by Prescott & Croasdale, *Trans. Amer. Microsc. Soc.* 56: 270, f. 9 (1937), under the name *Eucapsis alpina*. Plants of *E. alpina* Clem. & Shantz (if we can judge by the meager type material in the United States National Herbarium) have much smaller cells than do those of *Chroococcus Prescottii*; these cells are of a size and compact arrangement characteristic of *Merismopoedia glauca* (Ehrenb.) Kütz.; the gelatinous matrix is homogeneous. *Chroococcus Prescottii*, on the other hand, has large cells widely spaced in a gelatinous matrix that is often obscurely lamellose. The plants are very similar to those of *C. limneticus* Lemm., but with more regular arrangement of cells and less broad gelatinous matrix. This new species is named in honor of Professor Gerald W. Prescott of Albion College. Specimens seen, MASSACHUSETTS: Desmid Haven, West Falmouth, *H. Croasdale*, July 1935 (D), idem, *C. M. Palmer*, Aug. 1937 (TYPE in herb. F. Drouet; isotypes, C, F, N). MICHIGAN: Bryant's bog near Douglas lake, Cheboygan county, *H. A. Gleason Jr.*, July 1935 (T).



**ENTOPHYSALIS cryptarum** (Farl.) Drouet, **comb. nov.** (*Chroothecae* (?) *cryptarum* Farl. in Coll. Hold. & Setch. Phyc. Bor.-amer. 16: 752. 1900. Stratum gelatinosum, laete aerugineum vel luteolum vel fuscum vel roseum, 3—4 mm. crassum, filis 1-pluri-cellularibus, tortuosis, compacte aggregatis, ramosis; vaginis hyalinis vel luteis, arcte delimitatis, conspicue lamellosis; cellulis aerugineis, sphaericis vel cylindricis,  $2\ \mu$  ad  $4\ \mu$  crassis, praecipuius ad  $5\ \mu$  longis, haud raro usque ad  $6\ \mu$  longis, protoplasmate non granuloso.—On wet limestone. As noted by Farlow, this species is reminiscent of the the green alga *Urococcus*; in habit and in certain morphological details it resembles *U. Hookerianus* (Hass.) Kütz. Because of the strictly filamentous structure of the plants, it is placed here in Entophysalis. Specimens seen, BERMUDA: in caves by the seashore, *W. G. Farlow*, Jan. 1900 (TYPE in Farlow Herbarium; isotype in Phyc. Bor.-amer. 752, FM); Aggar's cave, *Farlow*, 1881 (F). PUERTO RICO: high littoral in sluice-way, San Juan, *M. A. Howe* 2130, May 1903 (F). JAMAICA: on wall of a littoral cavern below Fort Clarence near Kingston, *Howe* 4651, Dec. 1906 (FM). GUATEMALA: rocks and cliff, Rio Dulce above Livingston, Dept. Izabal, *J. A. Steyermark* 39439, 39440, Apr. 1940 (FM). VENEZUELA: wet rocks, Margarita island, *A. F. Blakeslee*, 1903 (F).

**DERMOCARPA Gardneriana** Drouet, **sp. nov.** Stratum violaceum compactum, plantis saepe inter alias algas sedentarias crescentibus; cellulis plus minusve compactis, aerugineis vel violaceis, inferne sphaericis vel cum mutua pressione polyhedroideis, vulgo circa  $3\ \mu$  ad  $10\ \mu$  crassis, superne crassioribus atque haud raro perfecte sphaericis diametro usque ad  $40\ \mu$  crassis, protoplasmate homogeneo, membrana cellulae tenui hyalina; cellulis grandis in pluribus gonidiis dividitibus.—On rocks and shells in fresh water. This species, with its compact strata of many spherical cells, resembles closely *D. violacea* Crouan of marine habitats. The plants are readily parasitized by fungi. This species is named in memory of the late Professor Nathaniel L. Gardner of the University of California. Specimens seen, FLORIDA: on stones, Gainesville, *M. A. Brannon* 40, Feb. 1942 (FM); in a collecting bottle, Gainesville, *Brannon* 47, Mar. 1942 (FM). NEBRASKA: on pebbles in creek bed 8 miles north of Max, Dundy county, *W. Kiener* 10595, July 1941 (FM). CALIFORNIA: culture of algae from Lake Merced, San Francisco, *Gardner* 6837, Oct. 1931 (TYPE in Cryptogamic Herbarium of Field Museum; isotype, C); on shells, Mountain lake, San Francisco, *W. J. V. Osterhout & Gardner*, June 1902 (as *Pleurocapsa concharum* in Phyc. Bor.-amer. 1051, FM); on dripping rocks in hot water, the Geysers,

Sonoma county, *Gardner & L. Bonar* 7519, Aug. 1933 (C, FM); in warm water on a cement runway, Seigler hot springs, Napa county, *Gardner* 7474, Aug. 1933 (C, FM).

**DERMOCARPA Setchellii** Drouet, **sp. nov.** Stratum violaceum, tenue, late effusum, cellulis compactis, violaceis, inferne sphaericis vel polyhedroideis, vulgo circa  $3\ \mu$  usque ad  $6\ \mu$  crassis, superiore crassioribus atque ovoideis vel pyriformibus vel plus minusve cylindraceis usque ad  $15\ \mu$  crassis et  $25\ \mu$  longis, protoplasmate homoganeo, membrana cellulae tenui hyalina; cellulis grandis in pluribus gonidiis dividitibus.—On rocks in warm fresh water. The ovoid and pyriform upper cells in the stratum distinguish this species easily from *D. Gardneriana* and from *D. violacea* Crouan. It is named in honor of Professor William A. Setchell of the University of California. Specimens seen, CALIFORNIA: Harlem hot springs, San Bernardino county, *Setchell* 1560, Dec. 1896 (TYPE in Cryptogamic Herbarium of Field Museum; isotype, C).

**DERMOCARPA Hollenbergii** Drouet, **sp. nov.** Cellulae solitariae vel aggregatae, epiphyticae, aerugineae vel violaceae, sphaericae vel cum mutua pressione polyhedroideae, diametro vulgo  $3\ \mu$  ad  $15\ \mu$  (usque ad  $20\ \mu$ ) crassae, protoplasmate homoganeo vel sparse grosse-granuloso, membrana cellulae tenui hyalina; cellulis grandis in pluribus gonidiis dividitibus.—Epiphytic on filamentous algae in fresh water. This species resembles most closely *D. Schousboei* (Thur.) Born. of brackish and marine waters. It is named in honor of Professor George J. Hollenberg of the University of Redlands. One collection seen, CALIFORNIA: on Rhizoclonium in a small pond at Old Woman springs, Mojave desert, *Hollenberg* 2084, May 1937 (TYPE in herb. F. Drouet).

**DERMOCARPA Solheimii** Drouet, **sp. nov.** Cellulae epiphyticae aerugineae, solitariae vel aggregatae, sphaericae vel subcylindraceae vel subpyriformes, diametro vulgo  $2\ \mu$  ad  $4\ \mu$  (usque ad  $5\ \mu$ ) crassae, ad  $5\ \mu$  longae, protoplasmate homoganeo, membrana cellulae tenui indistincta hyalina; cellulis grandis in paucis gonidiis dividitibus.—Epiphytic on larger algae and on roots of vascular plants in fresh water. This species is rather similar to but smaller than the marine *D. Schousboei* (Thur.) Born. and the freshwater *D. Hollenbergii* Drouet. It is named in honor of Professor W. G. Solheim of the University of Wyoming. Specimens seen, WYOMING: in stream in an open meadow above University Camp, Medicine Bow national forest, *Solheim* 53, June 1933 (TYPE in Cryptogamic Herbarium of Field Museum), idem 108, July 1933 (FM).

**DERMOCARPA minuta** Drouet, **sp. nov.** Cellulae epiphyticae aerugineae solitariae vel aggregatae, sphaericae ad subcylindraceae vel ovoidea, diametro  $1\ \mu$  ad  $3\ \mu$  crassae, usque ad  $4\ \mu$  longae, protoplasmate homoganeo, membrana cellulae indistincta hyalina.—Epiphytic on filamentous algae in fresh water. This is the smallest of the species of *Dermocarpa*; if the cells were not of so brilliant a blue-green color they might well be interpreted as bacteria. *D. minuta* is related morphologically to *D. Solheimii* described above and *D. Schousboei* (Thur.) Born. Specimens seen, CALIFORNIA: culture of algae from Tiburon, Marin county, *N. L. Gardner 6916*, Oct. 1931 (TYPE in Cryptogamic Herbarium of Field Museum; isotype, C); in an aquarium, University of California, Berkeley, *Gardner 8012*, Nov. 1936 (C, FM).

**FREMYELLA striatula** (Hy) Drouet, **comb. nov.** *Microchaete striatula* Hy Journ. de Bot. 1: 193. 1887. *Leptobasis striatula* (Hy) Elenk. Bull. Jard. Bot. Imp. Pierre le Grand 15: 21. 1915.—J. DeToni in Noter. Nomencl. Algol. VIII (1936) proposed the generic name *Fremyella* to supplant the preoccupied *Microchaete* Thur. ex Born. & Flah.

**FREMYELLA longifila** (W. R. Tayl.) Drouet, **comb. nov.** *Calothrix longifila* W. R. Tayl. Carnegie Inst. Wash. Papers Tortugas Lab. 25: 51, pl. 2, f. 8. 1928.—The type of this species in herb. Wm. R. Taylor (FLORIDA: on *Cladophora* and *Chaetomorpha* at moat, Garden key, Dry Tortugas, *Taylor 134*, June 1924) contains filaments of a species more properly referred to as a member of the genus *Fremyella* than one of *Calothrix*, as the author's description and figure indicate.

**PORPHYROSIPHON Velasquezii** Drouet, **sp. nov.** Stratum aerugineum vel fusco-viride, crustosum, late expansum, filis longis, inferne tortuosis et compacte intertextis, superne in fasciculos breves coalitis; vaginis primum hyalinis demum pallide roseis et fusco-rubris, tenuibus, inconspicue lamellosis, chlorozincico iodurato caerulescentibus; trichomatibus aerugineis,  $3\ \mu$  ad  $5\ \mu$  crassis, ad genicula paullo constrictis, ad apices leviter attenuatis; articulis diametro usque ad duplo longioribus, dissepimentis pellucidis non granulatis, protoplasmate aerugineo tenui-granuloso; cellula apicali conica, membrana superna non incrassata. Fig.—5. Forming crusts on soil wet intermittently with fresh water. The trichomes are smaller than those of *P. fuscus* Gom. and, unlike those of the latter species, are constricted at the cross-walls. This species is named in honor of Dr. Gregorio T. Velasquez of the University of the

Philippines. Specimens seen, PHILIPPINES: side of the campus usually wet with fresh water from the laboratory, Biological Station, Puerto Galera, Mindoro, *Velasquez 1077*, May 1941 (TYPE in Cryptogamic Herbarium of Field Museum); along the path at Dulangan, Puerto Galera, Mindoro, *Velasquez 1093*, May 1941 (FM); along the sidewalk of Pennsylvania street, Ermita, Manila, *Velasquez 98*, Nov. 1939 (FM).

*SCHIZOTHRIX rivularis* (Wolle) Drouet, **comb. nov.** *Lyngbya Phormidium* var. *rivularis* Wolle ex Forti Syll. Myxophyc. 304. 1907; Wolle Fresh Water Alg. U. S. 299, pl. cci, f. 21. 1887. *Symploca Muscorum* var. *rivularis* Tild. ex Forti loc. cit. 1907. Caespites molles gelatinosae fasciculatae ad 10 cm. altae, superne aerugineae vel violaceae, intus et inferne decoloratae, vaginis hyalinis, superne tenuibus, inferne crassis, saepe omnino diffluentibus, chlorozincico iodurato laete caerulescentibus; trichomatibus aerugineis vel roseis, fragilibus, facile disintegrantibus, 5  $\mu$  ad 11  $\mu$  crassis, ad genicula constrictis, ad apices attenuatis et conicis; articulis subquadratis, plus minusve brevioribus vel longioribus, dissepimentis non granulatis, protoplasmate granulos refringentes majores continenti; cellula apicali longe et obtuse conica.—On rocks, larger plants, and other substrata in running fresh water. This is a very delicate species of Gomont's section *Inactis*, related morphologically to *S. tinctoria* Gom. and *S. mexicana* Gom. Unless fresh material is dried very rapidly, the trichomes disintegrate and stain the mounting paper violet. This fact led me to infer in Field Mus. Bot. Ser. 20: 54 (1939) that Wolle's original specimens were impossible to identify with known species of Myxophyceae. In many respects *S. rivularis* reminds one of *Phormidium tinctorium* Gom., especially in plants with the sheaths totally diffluent. The brilliantly blue color produced in the sheath material during treatment with chlor-zinc-iodine is very characteristic of *Schizothrix rivularis* but never seen in *Phormidium tinctorium*. Moreover, in the latter the apices of the trichomes are short-conical; in the former they are long-attenuate and very similar to those of *Schizothrix purpurascens* Gom. The specimens distributed as *Symploca Muscorum* var. *rivularis* in Tild. Amer. Alg. 67 are referred to below under *Lyngbya Giuseppei*. Specimens of *Schizothrix rivularis* seen, QUEBEC: attached to water plants in the St. Lawrence river, Longueuil near Montreal, *J. Brunel 31*, Aug. 1930 (FM); Back river near Montreal, *Brunel 57*, Sept. 1930 (FM). PENNSYLVANIA: attached to stones in the Lehigh river, *F. Wolle*, 1878 (TYPE in Herbarium of the University of Pennsylvania), idem July 1879 (F, N, P). VIRGINIA: attached to sub-

merged debris in Wolf creek about 5 miles east of Rocky Gap, Bland county, *E. S. Luttrell & J. C. Strickland 1003*, Aug. 1941 (FM). OHIO: wet rocks of waterfall, Burnet Woods lake, Cincinnati, *L. Lillick & Lee 260*, Oct. 1933 (D). WISCONSIN: Plum creek, Sayner fish hatchery, Vilas county, *G. W. Prescott 3w33*, Aug. 1938 (FM); Barber lake, Chippewa drainage, Sawyer county, *Prescott 3w197*, Aug. 1938 (FM).

*SCHIZOTHRIX roseola* (Gardn.) Drouet, **comb. nov.** *Symploca roseola* Gardn. Mem. N. Y. Bot. Gard. 7: 49. 1927. *Leptothrix symplocoides* Dickie Journ. Linn. Soc. Bot. 15: 240. 1876 [not *Schizothrix symplocoides* (Gardn.) Geitl. Rabenh. Krypt.-Fl. 14: 1078. 1932]. *Schizothrix rosea* Gardn. N. Y. Acad. Sci. Sci. Surv. Porto Rico 8: 287. 1932 [not Gardn. Mem. N. Y. Bot. Gard. 7: 53 1927]. Stratum roseum vel fuscum, crustaceum, filis tenuibus, tortuosis, flexilibus, superne in fasciculos erectes vel repentes coalitis, inferne pseudoramosis; vaginis primum hyalinis et tenuibus demum roseis vel fusco-rubris et crassioribus, erosis, chlorozincico iodurato caerulescentibus; trichomatibus aerugineis,  $1\ \mu$  ad  $2.5\ \mu$  crassis, cylindraceis, ad genicula passim leviter constrictis, ad apices non attenuatis; cellulis subquadratis vel diametro longioribus, dissepimentis interdum granulatis, protoplasmate praecipue homoganeo; cellula apicali rotundata.—On rocks and soil periodically wet with fresh water. This species belongs in Gomont's section Chromosiphon with other species possessing red sheaths. Although in Amer. Journ. Bot. 25: 665 (1938) I cited *Leptothrix symplocoides* Dickie as a synonym of *Schizothrix lardacea* Gom., further studies of the type material show that the sheaths are red in older and exposed parts of the mass. Gardner described similar material from Puerto Rico in 1927 under the name *Symploca roseola*. Another specimen of the same thing is cited by him as the type of *Schizothrix rosea* in his 1932 paper in correcting an editorial error in his 1927 paper wherein the intended description of *S. rosea* was omitted and that of his *S. chalybea minor*, Sci. Surv. Porto Rico 8: 287 (1932) [which I interpret from the original specimens as typical *S. purpurascens* var. *cruenta* Gom.] was substituted in its place. *S. rosea* Gardn. as published in Mem. N. Y. Bot. Gard. 7: 53 (1927) must be regarded (even in the most liberal and sympathetic interpretation) strictly as having priority over *S. chalybea minor* Gardn. and as constituting an earlier homonym of *S. rosea* Gardn., Sci. Surv. Porto Rico 8: 287 (1932). Geitler in Rabenh. Krypt.-Fl. 14: 1101 (1932) has written a description for *S. rosea* Gardn. which applies to neither of the type specimens referred to by Gardner. Specimens seen, FLORIDA: on moist sand,

region of Hendry creek about 10 miles south of Fort Myers, Lee county, *P. C. Standley* 73463, Mar. 1940 (FM). ALABAMA: Auburn, Lee county, *C. L. Pollard & W. R. Mazon* 64, July 1900 (FM, U). WYOMING: hot lake deposit, Fountain geyser basin, Yellowstone National Park, *W. A. Setchell*, 1898 (C, FM). PUERTO RICO: 10 km. north of Utuado, *N. Willie* 1032b (isotype of *Symploca roseola* Gardn., C); Mayaguez, *Wille* 880c (isotype of *S. rosea* Gardn. 1932, C, FM). GUATEMALA: on muddy bank near Puerto Barrios, Dept. Izabal, *Standley* 72569a, Apr.-May 1939 (FM). NETHERLANDS EAST INDIES: fumarole of volcano, Gunong Api, Banda islands, *H. N. Moseley*, Challenger Expedition (TYPE of *Leptothrix symplocoides* Dickie in British Museum (Natural History)).

**SCHIZOTHRIX Giuseppei** Drouet, **nom. nov.** *Microcoleus sociatus* var. *minor* Gardn. Mem. N. Y. Bot. Gard. 7: 57, pl. 11, f. 6. 1927 [not Gardn. *ibid.* 7: 54. 1927]. Stratum aerugineum vel nigro-aerugineum, crustaceum, filis longis fasciculatim ramificantibus, inferne intertextis, superne in fasciculos erectos repentesve saepe tortos coalitis; vaginis primum hyalinis demum interne pallide caeruleis vel chalybeis, latis, lamellosis, ambitu erosis, chlorozincico iodurato laete caerulescentibus; trichomatibus aerugineis vel luteolo-aerugineis, longis, rectis, fragilibus,  $2\ \mu$  ad  $4\ \mu$  crassis, ad genicula non constrictis, ad apices abrupte attenuatis et acuminatis, articulis diametro usque ad 3-plo longioribus, dissepimentis haud granulatis, protoplasmate non aut vix granuloso, cellula apicali longe et plus minusve acute conica.—On soil and rocks wet intermittently with fresh water. This species belongs with other blue-sheathed species of Gomont's Section *Chromosiphon*. The new name, in honor of Dr. Giuseppe DeToni of Brescia, is proposed to replace the second of the two *Microcoleus sociatus* vars. *minor* published by Gardner in the same paper. It is true that five years later Gardner in *Sci. Surv. Porto Rico* 8: 286 (1932) recorded the trinomial *Schizothrix thelephoroides minor* to supplant the *Microcoleus sociatus* var. *minor* of Mem. N. Y. Bot. Gard. 7: 54 (the type material of which proves to be the very usual and typical *Schizothrix thelephoroides* Gom.), but he did not indicate its subspecific status. It is hoped that the new name, *S. Giuseppei*, will obviate the confusion and ambiguity of this peculiar situation. Specimens seen, PUERTO RICO: on limestone, Arecibo to Hatillo, *N. Wille* 1392a, Feb. 1915 (isotypes, C, FM). SONORA: on a gravel bank at foot of Sierra de Calera south of Villa de Seris, *Drouet & D. Richards* 2937, Nov. 1939 (FM).

**HYDROCOLEUM confluens** (Setch. & Gardn.) Drouet, **comb. nov.** *Microcoleus confluens* Setch. & Gardn. Univ. Calif. Publ. Bot. 6: 471, pl. 40. f. 25. 1918.—This species is undoubtedly a *Hydrocoleum*, with trichomes reminiscent of those of *H. lyngbyaceum* Gom. Specimens seen, CALIFORNIA: on rocks, Lands End, San Francisco, *N. L. Gardner* 1641, Jan. 1906 (TYPE in Herbarium of the University of California; isotype, FM), idem 3694, Mar. 1917 (C, FM); on boards at high tide mark, Presidio, San Francisco, *Gardner* 4481, Nov. 1919 (C, FM).

**PLECTONEMA Cloverianum** Drouet, **sp. nov.** Stratum expansum ad dua millimetra crassum gelatinosum pannosum laete aerugineum, filis flexilibus, elongatis, compacte intertextis vel superne parallelis, in spiras laxas regulares contortis, haud raro irregulariter tortilibus interdum rectis, inferne sparse pseudo-ramosis; vaginis cylindraceis firmis, primum arctis et laevibus, aetate provecta crassioribus, chlorozincico iodurato laete caerulescentibus; trichomatibus circa  $2\ \mu$  crassis, ad genicula constrictis (in speciminibus in formalina conservatis), ad apices quasi-capitatis non attenuatis; articulis diametro trichomatis usque ad quadruplo longioribus, ad apices brevioribus, dissepimentis binis granulis crassis vulgo notatis, protoplasmate passim granuloso; cellula apicali obovoidea, membrana superna non incrassata. Fig. 3.—On wet rocks and cliffs. The species is perhaps most closely related to *P. Nostocorum* Gom., but the trichomes are more robust and the filaments are characterized by the coiled habit noted above. *P. Cloverianum* is named in honor of Professor Elzada U. Clover of the University of Michigan. Specimens seen, COLORADO: on sandstone cliff near Dolores river, Montezuma county, *G. Piranian*, July 1935 (FM). UTAH: on limestone ledge on the south wall of the main canyon above Dark canyon rapids, Colorado river, San Juan county, *Clover & L. Jotter* 35 (FM), 36 (TYPE in Herbarium of the University of Michigan; isotype, FM), July 1938.

**LYNGBYA Chungii** Drouet, **sp. nov.** Caespites violaceae usque ad 4 centimetra longae, lubricae, filis rectis saepe flexuosis, fragilibus; vaginis arctis, tenuibus, hyalinis, chlorozincico iodurato non aut vix caerulescentibus; trichomatibus pallide violaceis,  $4\ \mu$  ad  $6\ \mu$  crassis, ad genicula non aut passim leviter constrictis, ad apices non attenuatis; articulis subquadratis vel diametro usque duplo longioribus, dissepimentis non granulatis, protoplasmate non granuloso, cellula apicali rotundata, membrana superna leviter incrassata.—On rocks in marine waters. This new species is very similar to the epiphytic *L. gracilis* Gom., but the cells are much longer than

those of the latter species. It is named in honor of Professor H. H. Chung. Specimens seen, CHINA: on rock, seashore, Kulangsu, Amoy, Fukien province, *Chung A624*, July 1926 (TYPE in Herbarium of the University of California; isotype, FM), *Chung A594*, June 1926 (C).

**LYNGBYA Giuseppei** Drouet, *sp. nov.* Caespites ad tria centimetra altae, molles, aerugineae vel roseae, filis longis flexilibus; vaginis hyalinis papyraceis haud lamellosis, chlorozincico iodurato laete caerulescentibus; trichomatibus aerugineis vel pallide roseis, ad genicula leviter constrictis, ad apices non attenuatis,  $5\ \mu$  ad  $10\ \mu$  crassis; articulis curtis diametro 3-6-plo brevioribus, dissepimentis passim granulatis, protoplasmate tenui-granuloso; cellula apicali rotundata, membrana superna non aut vix incrassata. Fig. 8.—In fresh water. This species is somewhat similar to *L. putealis* Gom., but with shorter cells and less constricted trichomes. It is named in honor of Professor Giuseppe DeToni of Brescia. Specimens seen, NEW YORK: on brick and plaster sides of spring, Lebanon Springs, Columbia county, *A. K. Harrison*, Jan. 1895 (TYPE in herb. F. Drouet; isotype, F). MINNESOTA: attached to stones in aquaria in the zoological laboratory, Minneapolis, *J. E. Tilden*, Nov. 1894 (as *Symploca Muscorum* var. *rivularis* in Tild. Amer. Alg. 67, FM).

**LYNGBYA Patrickiana** Drouet, *sp. nov.* Caespites aerugineae ad 5 cm. altae molles, filis longis rectis fragilibus; vaginis primum membranaceis demum crassioribus et lamellosis, chlorozincico iodurato laete caerulescentibus; trichomatibus aerugineis cylindraceutis,  $5\ \mu$  ad  $10\ \mu$  crassis, ad genicula haud constrictis, ad apices non attenuatis; articulis diametro 3-6-plo brevioribus, dissepimentis conspicuis, non aut subtiliter granulatis, protoplasmate tenui-granuloso; cellula apicali rotundata, membrana superna non aut vix incrassata. Fig. 10.—On rocks and wood in fresh water. This species is similar in general appearance to *L. Giuseppei* described above, but the sheaths are more robust, the trichomes never constricted, and the cross-walls not granulated. *L. Patrickiana* is named in honor of Dr. Ruth Patrick of the Academy of Natural Sciences, Philadelphia. Specimens seen; FLORIDA: about 10 miles from Hollywood on highway F149, Broward county, *Patrick*, 1939 (TYPE in Cryptogamic Herbarium of Field Museum); freshwater pool, region of Hendry creek about 10 miles south of Fort Myers, Lee county, *P. C. Standley 73246*, Mar. 1940 (FM). CEARA: on rocks in Rio Maceió near Mucuripe, Fortaleza, *S. Wright 2061*, Mar. 1937 (D).



LYNGBYA **guaymensis** Drouet, **sp. nov.** Fila inter alias algas subsalsas crescentia, longa, tortilia, plus minusve rigida, aeruginea, vaginis hyalinis, primum tenuibus demum crassioribus, ambitu saepe erosis, chlorozincico iodurato non caerulescentibus; trichomatibus aerugineis,  $2\ \mu$  ad  $4\ \mu$  crassis, ad genicula evidenter constrictis, ad apices non attenuatis; articulis diametro vulgo brevioribus raro subquadratis, dissepimentis non granulatis, protoplasmate haud granuloso; cellula apicali rotundata, membrana externa non incrassata. Fig. 9.—Growing in muck in brackish pools along the seashore. But for the rigid habit, the distinctly constricted trichomes, the reaction of the sheath to chlor-zinc-iodine, and the lack of granules at the cross-walls, this species is reminiscent of the freshwater *L. versicolor* Gom., to which it seems most closely related. The filaments are also somewhat similar to those of the epiphytic marine *L. Simmonsi* (Coll.) Drouet and the marine *Plectonema Battersii* Gom. Specimens seen, SONORA: in the margin of a brackish pond, cove north of Cabo Arco, Guaymas, *Drouet & D. Richards 3344*, Dec. 1939 (TYPE in Cryptogamic Herbarium of Field Museum), idem *3338, 3339, 3341* (FM); in shallow brackish water of a sand pit on beach 4 km. east of Guaymas, *Drouet & Richards 3295, 3296*, Dec. 1939 (FM). GUATEMALA: salt flat near San José, Dept. Escuintla, *P. C. Standley 63979*, Jan. 1939 (FM).

PHORMIDIUM **minnesotense** (Tild.) Drouet, **comb. nov.** *Oscillatoria minnesotensis* Tild. Amer. Alg. 6: 596. 1902. Stratum pulchre aerugineum tenue gelatinosum, vaginis diffluentibus hyalinis, chlorozincico iodurato haud caerulescentibus; trichomatibus aerugineis rigidis fragilibus rectis, compacte et paralleliter consociatis,  $2\ \mu$  ad  $3\ \mu$  crassis, ad genicula constrictis, ad apices non attenuatis; articulis subquadratis usque ad duplo brevioribus, dissepimentis non granulatis, protoplasmate homoganeo; cellula apicali rotundata, membrana superna non incrassata.—In shallow fresh water and on soil almost constantly wet with fresh water. The species belongs with other torulose members of the genus, perhaps next to *P. persicinum* Gom. Miss Tilden states that she described this as a species of *Oscillatoria* because the trichomes in the fresh material were oscillating rapidly; she here ascribes a property common to all species of the Oscillatoriaceae to those of a single genus. Specimens seen, TENNESSEE: greenhouse soil, Centennial park, Nashville, *H. C. Bold 164*, Oct. 1938 (FM). INDIANA: old bed of Whitewater river, Richmond, *L. J. King 81*, Sept. 1940 (FM). ILLINOIS: roadside ditch near Calumet lake, Chicago, *King & J. O. Young*, July

1941 (FM). MINNESOTA: on sides of a stone quarry under dripping water near university campus, Minneapolis, *G. Lilley*, Feb. 1902 (isotype in Tild. Amer. Alg. 596, FM). MISSOURI: margin of Goose lake 4 miles south of Clinton, Henry county, *C. Shoop & J. A. Steyermark* 201, Sept. 1938 (FM). NEBRASKA: emergent wet soil of pool, Lincoln, *W. Kiener* 10174, June 1941 (FM).

**PHORMIDIUM Groesbeckianum** Drouet, *sp. nov.* Stratum aerugineum tenue, saepe inter alias myxophyceas thermales crescens, vaginis hyalinis omnino diffluentibus, chlorozincico iodurato caerulescentibus; trichomatibus pallide aerugineis, rectis paralleliter consociatis, fragilibus, torulosis (aspectu trichomatum nostocaceorum), ad apices non attenuatis; articulis subsphaericis vel subdoliiformibus, diametro  $2\ \mu$  ad  $3\ \mu$  crassis, plus minusve subquadratis, dissepimentis non granulatis, protoplasmate haud granuloso; cellula apicali rotundata, membrana superna non incrassata. Fig. 7.—Forming gelatinous strata with other algae (often with *P. laminosum* Gom.) submerged and subaerial in hot springs. I have seen stray trichomes of this alga in collections from many hot springs in western North America, but the collection noted here is the only one in which the mass is sufficiently developed for description. The species is named in honor of M. J. Groesbeck, M. D., of Porterville, California. One specimen, NEVADA: in a hot spring (temperature  $110^{\circ}\text{F}$ ), Steamboat and Reno hot springs, Washoe county, *Groesbeck* 195a, Sept. 1940 (TYPE in Cryptogamic Herbarium of Field Museum).

**PHORMIDIUM Steyermarkii** Drouet, *sp. nov.* Stratum gelatinosum laete aerugineum, saepe pulvinatum et calcareum, intus decoloratum, vaginis hyalinis omnino diffluentibus, chlorozincico iodurato non aut vix caerulescentibus; trichomatibus aerugineis rectis fragilibus paralleliter coalitis,  $3\ \mu$  ad  $4\ \mu$  crassis, ad genicula evidenter constrictis, ad apices non attenuatis; articulis doliiformibus vel fere cylindraceis, subquadratis vel diametro usque ad  $1\frac{1}{2}$ —plo longioribus, dissepimentis non granulatis, protoplasmate haud granuloso; cellula apicali rotundata, membrana superna non incrassata. Fig. 11.—In the waters of hot springs. Morphologically, both *P. Steyermarkii* and the preceding *P. Groesbeckianum* are related to *P. foveolarum* Gom. The habit of this species is reminiscent of that of the anabaenoid state of *Hapalosiphon laminosus* Born. & Flah., but the trichomes appear to exist invariably as described above and to exhibit no transitional stages into typical *H. laminosus*. *Phormidium Steyermarkii* is named in honor of Dr. Julian A. Steyermark of Field Museum of Natural History. Specimens seen, GUATE-

MALA: Agua Caliente springs between La Fragua and Rio Motagua, Dept. Zacapa, *Steiermark* 29211, Oct. 1939 (TYPE in Cryptogamic Herbarium of Field Museum); in a hot spring and in pools of hot water, Laguna, Lake Amatitlan, *S. E. Meek* 59, 72, Jan. 1906 (FM).

**PHORMIDIUM californicum** Drouet, *sp. nov.* Stratum laete-vel atro-aerugineum, gelatinosum, late expansum, vaginis hyalinis, saepe plus minusve distinctis demum omnino diffluentibus, chlorozincico iodurato non caerulescentibus; trichomatibus aerugineis, dense et paralleliter consociatis, 3  $\mu$  ad 4  $\mu$  crassis, ad genicula constrictis, ad apices attenuatis et subacuminatis; articulis subcylindraceis vel subdoliiformibus, subquadratis vel diametro usque ad duplo longioribus, dissepimentis non granulatis, protoplasmate granuloso; cellula apicali conica, subacuta vel quasi-truncata. Fig. 12.—On woodwork, soil and other objects continuously wet with fresh water. The material placed here is very similar to that described elsewhere in this volume as *P. Weissii* Drouet, from brackish water along western Atlantic shores. The habitat, the general appearance of the stratum, the habit of the trichomes, and the reaction of the sheath-material with chlor-zinc-iodine are so different from those of *P. Weissii*, however, as to merit description as a new species. Specimens seen, CALIFORNIA: on a wooden bench in the conservatory, Golden Gate park, San Francisco, *Gardner* 7766, July 1935 (TYPE in Cryptogamic Herbarium of Field Museum; isotype, C), idem 6715, July 1931 (C, FM), idem 7254, 7254a, Apr. 1933 (C, FM), idem culture from the above, 7436, Aug. 1933 (C, FM); on boards, Plath's greenhouse, San Francisco, *V. Duran* 6588, Jan. 1931 (C, FM). SONORA: in shallow water in an adobe pit 4 km. southwest of Villa de Seris, *Drouet, D. Richards, & L. D. Alvarado* 2848, Nov. 1939 (FM).

**PHORMIDIUM thermale** Drouet, *sp. nov.* Stratum gelatinosum late expansum laete aerugineum, vaginis hyalinis diffluentibus plus minusve fibrosis, chlorozincico iodurato non caerulescentibus; trichomatibus aerugineis rectis parallelis fragilibus, 2  $\mu$  ad 5  $\mu$  crassis, torulosis, ad apices abrupte acuminatis; articulis doliiformibus vel subcylindraceis, subquadratis vel diametro usque ad duplo longioribus, protoplasmate homoganeo; cellula apicali ad basem rotundata, superne abrupte et saepe oblique acutissima. Fig. 13.—In warm water of hot springs. Except for the peculiar apical cells the trichomes are very similar to those of the anabaenoid growth-form of *Hapalosiphon laminosus*. *Phormidium thermale* is placed in the vicinity of *P. Weissii* Drouet and *P. californicum* Drouet, from

which it differs conspicuously in size of trichome and in configuration of the apical cell. Specimens seen, CALIFORNIA: Seigler hot springs, Lake county, *N. L. Gardner* 7463, Aug. 1933 (TYPE in Cryptogamic Herbarium of Field Museum; isotype, C); in warm pools, the Geysers, Sonoma county, *Gardner* 7509, Aug. 1933 (C, FM), idem *Gardner & L. Bonar* 7529, Aug. 1933 (C, FM, and distributed as *Hapalosiphon laminosus*), idem *Gardner & V. Duran* 7704, Apr. 1934 (C, FM, and distributed as *H. laminosus*).

**PHORMIDIUM *Hancockii*** (Drouet) Drouet, **comb. nov.** *Schizothrix Hancockii* Drouet *Hancock Pacific Exped.* 3 (2): 22, fig. 15. 1936. *S. Hancockii* f. *submersa* Drouet *ibid.* 3 (2): 23. 1936.—Further studies of the original material of this species shows that the structure of the sheath and of the stratum is that of a *Phormidium* rather than of a *Schizothrix*. *Phormidium Hancockii* is placed near *P. papyraceum* Gom.

**PHORMIDIUM *Richardsii*** Drouet, **sp. nov.** Stratum pannosum, fuscum vel roseum vel aerugineum, tenue, fragile, vaginis tenuibus saepe omnino diffluentibus, hyalinis, chlorozincico iodurato haud caerulescentibus; trichomatibus aerugineis 3  $\mu$  ad 7  $\mu$  crassis, longis parallelis flexilibus, ad genicula interdum leviter constrictis, ad apices longe attenuatis et acutis; articulis brevibus, diametro 6-plo brevioribus usque ad subquadratis, dissepimentis granulatis, protoplasmate tenui-granuloso vel homoganeo; cellula apicali longe et plus minusve acute (haud raro acutissime) conica, nonnumquam curvata. Fig. 15.—On barren soil intermittently wet with fresh water. The trichomes are reminiscent of those of *Oscillatoria brevis* Gom.; specimens are easily confused with juvenile masses of *Microcoleus vaginatus* Gom. and *M. lacustris* Gom. found in recently denuded ground, the filaments of which contain only one trichome within a sheath. This new species is named in honor of Mr. Donald Richards of the University of Chicago. Specimens seen, MONTANA: roadside pit 24 miles north of Millegan, Cascade county, *F. H. Rose* 4160, May 1941 (FM). NEW MEXICO: on drying mud flats in the city park, Hot Springs, Sierra county, *Drouet & Richards* 2702, Oct. 1939 (TYPE in Cryptogamic Herbarium of Field Museum), idem 2704, 2708, 2705 (FM); on denuded ground near the Rio Grande bridge, Hot Springs, Sierra county, *Drouet & Richards* 2707, Oct. (FM).

**PHORMIDIUM *Standleyi*** Drouet, **sp. nov.** Stratum late expansum pulvinatum gelatinosum, atrovioleaceum vel aerugineum, ad dua centimetra altum, vaginis hyalinis tenuibus demum omnino diffluentibus.

tibus, chlorozincico iodurato non caerulescentibus; trichomatibus aerugineis vel violaceis,  $5\ \mu$  ad  $7\ \mu$  crassis, ad genicula haud constrictis, ad apices non attenuatis; cellulis diametro 6–3-plo brevioribus, dissepimentis granulatis, protoplasmate granuloso; cellula apicali depresso-rotundata, membranam plus minusve incrassatam praebenti. Fig. 14.—Growing in thick mats in warm water of hot springs. This species is most nearly related morphologically to *P. ambiguum* Gom. It is named in honor of Mr. Paul C. Standley of Field Museum of Natural History. One collection seen, GUATEMALA: in warm water of hot spring, Baños de San Lorenzo near Tejar, Dept. Sacatepéquez, *Standley 59840*, Dec. 1938 (TYPE in Cryptogamic Herbarium of Field Museum).

**PHORMIDIUM hydrocoleoides** Drouet, *sp. nov.* Stratum aerugineum, tenue, vaginis hyalinis diffluentibus, chlorozincico iodurato aegre caerulescentibus; trichomatibus laete aerugineis, rectis, fragilibus,  $5\ \mu$  ad  $8\ \mu$  crassis, ad genicula leviter constrictis, ad apices attenuatis et capitatis; articulis diametro 2–5-plo brevioribus, dissepimentis granulatis, protoplasmate tenui-granuloso, cellula apicali capitata, calyptram depresso-hemisphaericam praebenti. Fig. 18.—On mud in brackish or almost salt water. The trichomes are somewhat reminiscent of those of *Hydrocoleum lyngbyaceum* Gom., but smaller and very different in color and granulation. The species is to be placed near the freshwater *Phormidium lucidum* Gom. One specimen, SONORA: on tidal flat along Rio Mayo on north side of Yavaros, southwest of Huatabampo, *Drouet & D. Richards 3220*, Dec. 1939 (TYPE in Cryptogamic Herbarium of Field Museum).

**PHORMIDIUM Gardnerianum** Drouet, *sp. nov.* Stratum laete aerugineum, tenue, fragile, vaginis diffluentibus, hyalinis, chlorozincico iodurato haud caerulescentibus; trichomatibus longis, flexilibus,  $4\ \mu$  ad  $6\ \mu$  crassis, ad genicula constrictis, ad apices longe attenuatis et capitatis, apicibus uncinatis; articulis subquadratis vel diametro usque ad duplo brevioribus, dissepimentis parce granulatis, protoplasmate pallide aerugineo, tenui-granuloso, cellula apicali capitata, membranam incrassatam rotundatam aut depresso-conicam praebenti. Fig. 17.—In marine waters. This species, except for the constricted trichomes, closely resembles the freshwater *P. uncinatum* Gom. It is named in honor of the late Professor Nathaniel Lyon Gardner of the University of California. One collection, CALIFORNIA: in a jar of sea water, University of California, Berkeley, *Gardner 2179*, 1910 (TYPE in Cryptogamic Herbarium of Field Museum; isotype, C).

**OSCILLATORIA sonorensis** Drouet, *sp. nov.* Stratum tenue, fragile, laete aerugineum, trichomatibus longis, rectis,  $3\ \mu$  ad  $5\ \mu$  crassis, aerugineis, ad genicula vix constrictis, ad apices abrupte attenuatis et curvatis; articulis quadratis vel diametro usque ad duplo longioribus, dissepimentis conspicuis haud granulatis, protoplasmate homoganeo, cellula apicali longe conica, acuta, curvata. Fig. 16.—In marine or almost marine water. This species is rather similar to the thermal *O. acuminata* Gom., but differs markedly in the type of granulation of the protoplasm and in its less attenuate and acuminate apices of the trichomes. One collection, SONORA: in a tide pool on muddy shore of bay near the refrigerating plant, Empalme, Drouet & D. Richards 3419, Dec. 1939 (TYPE in Cryptogamic Herbarium of Field Museum).

**ARTHROSPIRA Khannae** Drouet & J. C. Strickland, *sp. nov.* Trichomata planctonica in flore-aquae crescentia, aeruginea, in spiram laxam amplissimam diametro circa  $20\ \mu$  contorta, ad genicula haud constricta, ad apices leviter attenuata et subcapitata,  $3\ \mu$  ad  $5\ \mu$  crassa; anfractus circa  $20\ \mu$  inter se distantibus; articulis brevibus, diametro 3-plo brevioribus usque ad subquadratis, dissepimentis granulatis, protoplasmate pseudovacuolas grandes continenti. Fig. 6.—Planktonic in bodies of fresh water. This species is similar in many respects to *A. platensis* Gom. but conspicuously smaller in size. It is named in honor of Professor L. P. Khanna of University College, Rangoon. Specimens seen, BURMA: pond near the zoological garden, Rangoon, Khanna 698, Apr. 1937 (TYPE in Cryptogamic Herbarium of Field Museum), idem 697 (FM); Agricultural Gardens, Rangoon, Khanna 714, May 1937 (FM).

**SPIRULINA Weissii** Drouet, *sp. nov.* Trichomata  $3\ \mu$  ad  $4\ \mu$  crassa, inter alias algas plus minusve paralleliter agglomerata, fragilis, recta vel irregulariter curvata, in spiram regularem densam diametro  $10\ \mu$  ad  $12\ \mu$  contorta; anfractus contiguus vel subcontiguus; protoplasmate grosse-granuloso. Fig. 19.—In brackish water. The spiral habit of this species is similar to that of *S. subsalsa* Gom., but the trichomes are much larger than those of the latter. It is named in honor of Mr. Philip Weiss Wolle of Princess Anne, Maryland. One collection, MARYLAND: in shallow pools of brackish water, Jericho marshes west of Fairmount, Somerset county, Drouet & Wolle 3650, July 1940 (TYPE in Cryptogamic Herbarium of Field Museum).



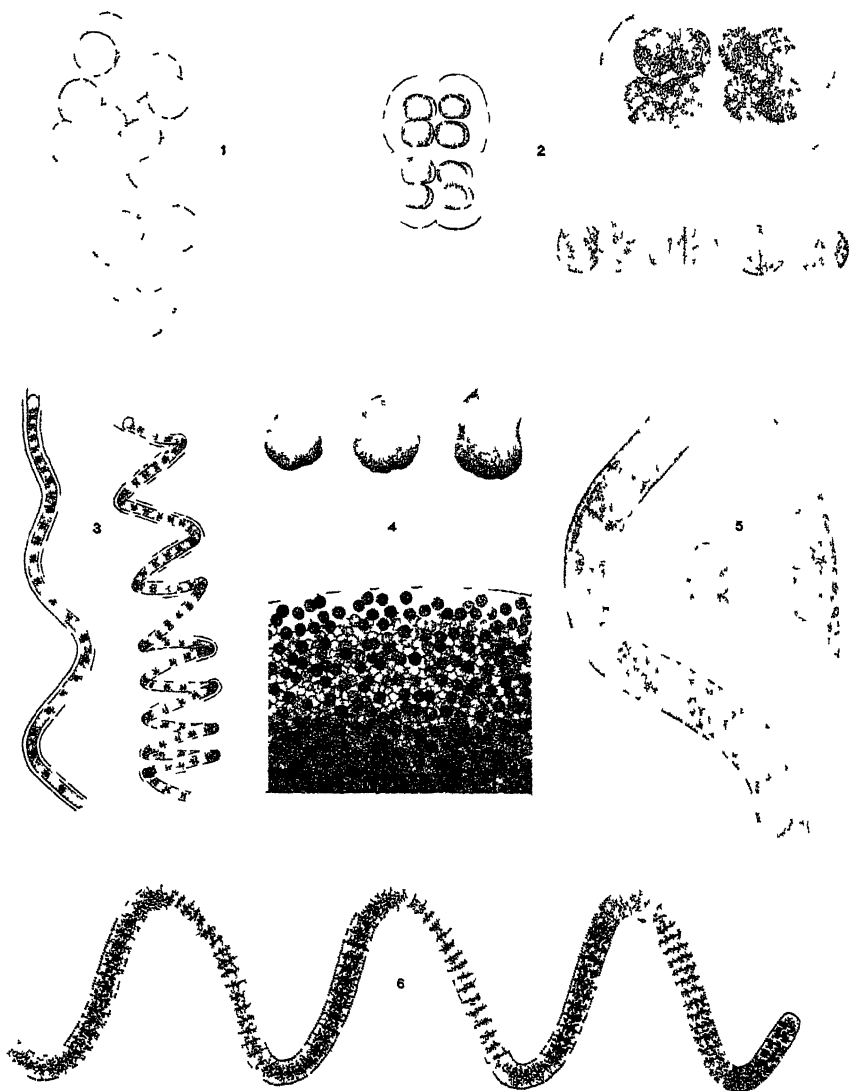


Plate I. Fig. 1. *Chroococcus sonorensis*. Fig. 2. *C. Prescottii*, two plants and several cells in division. Fig. 3. *Plectonema Cloverianum*. Fig. 4. *Aphanocapsa Farlowiana*, habit of plants above and arrangement of cells below. Fig. 5. *Porphyrosiphon Velasquezii*, details of filament and trichomes, the apices in various stages of growth. Fig. 6. *Arthrospira Khannae*. All drawn from type material by Raymond Taran except for the smaller plant of Fig. 2, which was made by William A. and Fay K. Daily.



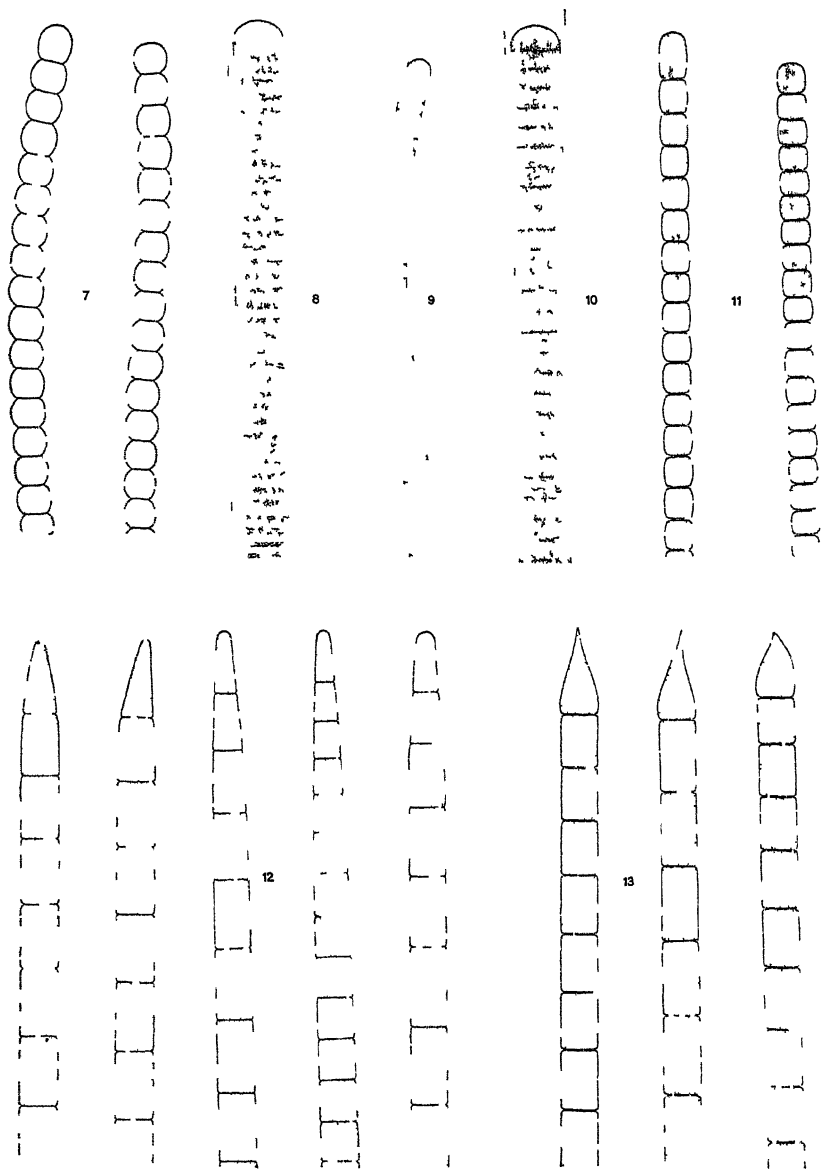


Plate II. Fig. 7. *Phormidium Groesbeckianum*, two trichomes. Fig. 8. *Lyngbya Giuseppei*. Fig. 9. *L. guaymensis*. Fig. 10. *L. Patrickiana*. Fig. 11. *Phormidium Steyermarkii*. Fig. 12. *P. californicum*, five trichomes. Fig. 13. *P. thermale*, three trichomes. All drawn from type material by Raymond Taran.

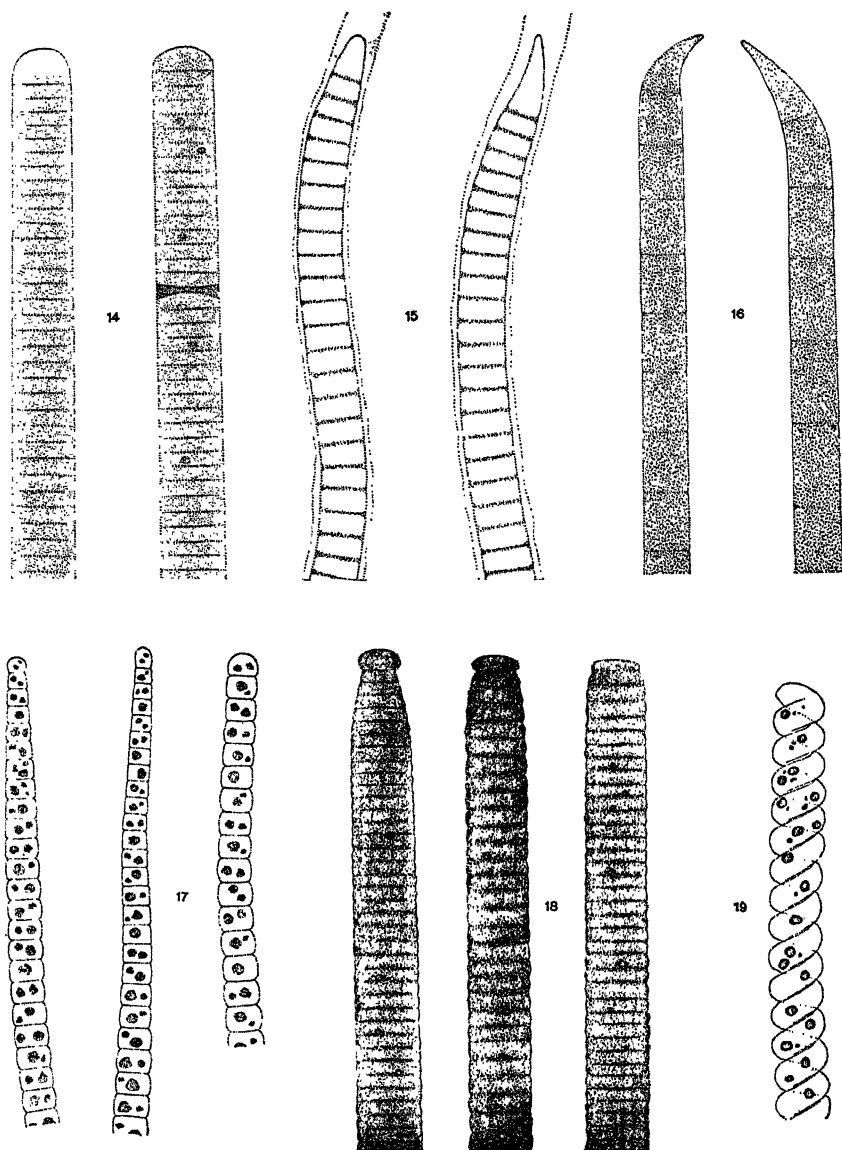


Plate III. Fig. 14. *Phormidium Standleyi*, two trichomes. Fig. 15. *P. Richardsii*, two filaments. Fig. 16. *Oscillatoria sonoriensis*, two trichomes. Fig. 17. *Phormidium Gardnerianum*, three trichomes. Fig. 18. *P. hydrocoleoides*, three trichomes. Fig. 19. *Spirulina Weissii*. All drawn from type material by Raymond Taran.



# MYXOPHYCEAE OF EASTERN CALIFORNIA AND WESTERN NEVADA

BY

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CURATOR OF CRYPTOGAMIC BOTANY



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# MYXOPHYCEAE OF EASTERN CALIFORNIA AND WESTERN NEVADA

FRANCIS DROUET

East, northeast, and southeast of the Sierra Nevada lies a rough, arid, scantily populated region extending to the Wasatch and Rocky mountains. Its western half includes all of western Nevada and that portion of California northeast and east of the Sierra Nevada in Modoc, Lassen, Sierra, Placer, Eldorado, Alpine, Mono, and Inyo counties and east of the San Gabriel and San Jacinto mountains in San Bernardino, Riverside, and Imperial counties. Hot and cold springs are abundant, especially along the eastern escarpment of the Sierra Nevada. The valleys and depressions are largely closed drainage-basins which contain salt lakes, dry salt flats, and playas, some below sea-level. The rainfall is slight, ranging from 3 to 15 inches a year in various parts of the area; water from this source persists throughout the year in bodies of water in some of the depressions. Small streams originating in the springs and melting snows in the high mountains also flow into the region. Freshwater lakes fed by springs or mountain streams are few and widely scattered.

In a region with so meager a supply of water it is to be expected that the algal flora contains many species of specialized habitats. Except in the immediate vicinity of streams, springs, and freshwater lakes, the vascular plants, mosses, and lichens do not form a continuous ground-cover; this is especially evident in the deserts of the south. Here the most abundant plant-growths are the crusts of algae which cover the soil. The hot springs and the streams which they feed are the habitats of totally different species of algae. The salt playas and alkaline lakes contain other species, while the cold springs and freshwater streams and lakes have still others.

Until recent years only occasional specimens of algae have been picked up in this region by botanical collectors. A Mrs. Partz of Benton, California, sent specimens from the hot springs there to H. C. Wood in August 1866. F. V. Coville and F. Funston collected a few specimens on the Death valley expedition of the United States Department of Agriculture in 1891. S. B. Parish preserved a number of algae during his exploration of southern California in 1891-1895. W. A. Setchell collected in the hot springs of the San Bernardino

mountains in 1896; he was followed in the same localities by H. E. Parks in 1929 and by N. L. Gardner in 1930. Random specimens have been taken since 1900 by Annetta Carter, V. Duran, David Griffiths, J. and H. W. Grinnell, H. M. Hall and E. B. Babcock, R. M. Holman and Lee Bonar, G. Evelyn Hutchinson, O. L. Inman, P. A. Munz, and Guy Wilkenson. George J. Hollenberg has made many collections in southern California from 1934 until the present date. M. J. Groesbeck took some four hundred collections at frequent intervals during 1940 and 1941 from the hot springs of Inyo and Mono counties, California, and Washoe county, Nevada; additional material was collected in Death valley and other localities in the region. On the Field Museum cryptogamic expedition to California in 1941, Francis Drouet and Donald Richards collected in the vicinity of Alturas in northeastern California, and Francis Drouet and J. Francis Macbride in the deserts of southern California.

I wish to thank particularly M. J. Groesbeck, M. D., of Porterville, California, for the opportunity to present here so complete a treatment of the myxophyceean flora of the region under consideration. Her large series of collections from many of the groups of hot springs and from other localities, accumulated with considerable personal expenditure of money and time, are excellently prepared and were gathered in sufficient numbers to give an adequate picture of the components of the flora in these places. She has been most generous and solicitous in furnishing supplementary information wherever needed. I am indebted to the late Professor W. A. Setchell and to the members of the Staff of the Herbarium of the University of California for their hospitality during my visit there in 1941 and for making available to me the numerous collections from the region in the general herbarium and in that of the late Professor Nathaniel L. Gardner. Mr. Donald Richards and Mr. J. Francis Macbride of Field Museum share the responsibility for the very profitable collecting of algae in California during the expedition of 1941. Mr. William A. Daily, Mr. J. C. Strickland, and Mr. Richards have offered many welcome suggestions concerning the manuscript. Miss Rosalie Weikert and Dr. Ruth Patrick gave much appreciated assistance with certain of the bibliographical details.

The specimens cited here are all on file in the Cryptogamic Herbarium of Field Museum (and for the most part represented by duplicates in the Herbarium of the University of California), except

where indicated by the following abbreviations as occurring in other herbaria: C, Herbarium of the University of California; D, Herbarium of Francis Drouet; F, Farlow Herbarium of Harvard University; N, New York Botanical Garden. Still other herbaria are referred to without abbreviation. Where precision has seemed desirable, the Cryptogamic Herbarium of Field Museum is designated by the abbreviation FM.

### Chroococcaceae

APHANOCAPSA GREVILLEI (Berk.) Rabenh. Fl. Eur. Alg. 2: 50. 1864; Daily Amer. Midl. Nat. 27: 640, f. 5. 1942. *Palmella Grevillei* Berk. Glean. Br. Alg. 16. 1833. *Coccochloris Grevillei* Hass. Hist. Brit. Freshw. Alg. 1: 318. 1845. *Anacystis Grevillei* Kütz. Sp. Alg. 209. 1849.—In shallow fresh water and on wet objects. Specimens seen, CALIFORNIA: Inyo county: in cold stream 1 ft. away from outlet of Keough hot springs, *Groesbeck* 230, Nov. 1940; on rock subject to steam and spray, the Geysers, *Groesbeck* 140, Sept. 1940.

GLOEOCAPSA VIOLACEA Kütz.<sup>1</sup> Tab. Phyc. 1: 25. 1847 (not Rabenh. Fl. Eur. Alg. 2: 41. 1865). *G. nigrescens* Näg. in Rabenh. Alg. 35 & 36: 629. 1857; Daily Amer. Midl. Nat. 27: 646, f. 13, 14, 37. 1942. *G. lignicola* Rabenh. Fl. Eur. Alg. 2: 41. 1865.—On objects kept moist during long periods of the year, seldom found submersed. Specimens seen, NEVADA: inside a tank of cold water, Steamboat, *Groesbeck* 190, 375, Sept. 1940, Apr. 1941. CALIFORNIA: Mono county: board on ground, Bridgeport, *Groesbeck* 331, Apr. 1941; stone in overflow of hot artesian well, north side of Mono lake, *Groesbeck* 129, Sept. 1940. Inyo county: about vent actively spitting drops of boiling water, Hot creek geysers, *Groesbeck* 418a, July 1941; first spring south of Triangle spring, Death valley, *Grinnell* 7625, Oct. 1933. San Bernardino county: on the trunk of a palm tree, Needles, *Drouet & Macbride* 4593, Oct. 1941; Waterman hot springs, *Setchell* 1554, Dec. 1896.

<sup>1</sup> In taking up this name we note that Rabenhorst in Fl. Eur. Alg. 2: 41 (1865) proposed *G. lignicola* to supplant Kützing's *G. violacea* (as represented by specimens distributed in Rabenh. Alg. 2031, FRANCE: sur l'écorce des peupliers tremble et ypréau, env. de Paris et de la Falaise, A. de Brébisson [FM, N]) in order to make the new combination *G. violacea* (Corda) Rabenh. based upon *Proto-coccus violaceus* Corda. We have no choice here but to employ the earlier homonym. Original specimens of *G. nigrescens* Näg., SWITZERLAND: an einem Brunnen bei Kussnacht unweit Zürich, *Wartmann* (Rabenh. Alg. 629, FM), contain plants similar to those of *G. violacea* Kütz.—F. DROUET AND WILLIAM A. DAILY.



GLOEOCAPSA MAGMA (Bréb.) Kütz.<sup>1</sup> Tab. Phyc. 1: 17. 1847; Daily Amer. Midl. Nat. 27: 645, f. 10-12, 17. 1942. *Protococcus magma* Bréb. in Bréb. & God. Alg. Falaise 40. 1845. *Pleurococcus magma* Menegh. Mem. R. Accad. Sci. Torino 2 ser. 5: 43. 1848. *Monocapsa stegophila* Itzigs. in Rabenh. Alg. 27 & 28: 263. 1853. *Gloeocapsa stegophila* Rabenh. Krypt.-Fl. Sachs. 1: 72. 1863. *G. Itzigsohnii* Born. apud Zopf Spaltplf. 69, Taf. 7, f. 6-9. 1882. *Entophysalis magnoliae* Farl. Mar. Alg. New Engl. 29. 1891. *Gloeocapsa magma* var. *Itzigsohnii* Hansg. Prodr. 2: 147. 1892. *Chroococcus Simmeri* Schmidle Allgem. Bot. Zeitschr. 1898: 158. 1898. *Gloeocapsa multisphaerica* Gardn. Univ. Calif. Publ. Bot. 14: 1. 1927.—On rocks and trees, apparently not commonly seen in western North America. One collection, CALIFORNIA: San Bernardino county: on quartz outcrops in rocky rolling ground near Mountain Spring camp northeast of Essex, Drouet & Macbride 4609, Oct. 1941.

CHROOCOCCUS RUFESCENS (Kütz.) Näg.<sup>2</sup> Gatt. einz. Alg. 46. 1848; Daily Amer. Midl. Nat. 27: 642, f. 9. 1942. *Protococcus rufescens* Kütz. Tab. Phyc. 1: 9. 1846. *Pleurococcus rufescens* Bréb. in Kütz. pro synonym., loc. cit. 1846. *Chroococcus helveticus* Näg. Gatt. einz. Alg. 46. 1848. *C. virescens* Hantzsch in Rabenh. Alg. 33 & 34: 1332. 1862. *C. granulatus* Zell. Hedwigia 1873: 169. 1873. *C. minutus* var. *virescens* Hansg. Prodr. 2: 162. 1892. *Gloeocapsa*

<sup>1</sup>A number of specimens labeled *Protococcus magma* Bréb. from Falaise, Calvados, and presumably originating in Brébisson's herbarium are present in the Farlow Herbarium, the cryptogamic herbarium of Field Museum, and the herbarium of F. Drouet. Similar to these in all morphological details are the following specimens which are the bases of other names cited here as synonyms of *Gloeocapsa magma*. BRANDENBURG: Neudamm, *Itzigsohn*, Dec. 1852 (isotype of *Monocapsa stegophila*, Rabenh. Alg. 263, FM). CARINTHIA: auf alten Holz, am Knoten, *H. Simmer*, Aug. 1897 (isotype of *Chroococcus Simmeri*, N). FRANCE: sur l'écorce de *Populus alba*, Versailles, *E. Bornet*, 1850 (isotype? of *Gloeocapsa Itzigsohnii*, F). MASSACHUSETTS: Magnolia, *W. G. Farlow*, Aug. 1871 (TYPE of *Entophysalis magnoliae*, F). CHINA: on wet rock, Kushan near Foochow, *H. H. Chung A363c*, Aug. 1926 (TYPE of *Gloeocapsa multisphaerica*, F).—F. DROUET AND W. A. DAILY.

<sup>2</sup>We base this name, the type species of *Chroococcus* Näg., upon the specimen in Rabenh. Alg. 2034 (FM): CALVADOS: couches épaisses sur les mousses inondées dans une cascade dans les Falaises près d'Arromanches, *A. de Brébisson*, labeled *Protococcus rufescens* Kütz., and upon another (FM) from Arromanches labeled *Pleurococcus rufescens* by Brébisson. These and the following original specimens, the bases of other names cited here as synonyms, appear to represent a single species. GERMANY: ges. in Aug. 1860, cultivirt bis Mai 1862, *C. A. Hantzsch* (isotype of *Chroococcus virescens* in Rabenh. Alg. 1332, N). SWITZERLAND: Erlenbacher Tobel an Felsen, Zürich, *Nägeli*, Sept. 1848 (specimen of *C. helveticus* by the author, FM). WISCONSIN: on boards, Osceola, *J. E. Tilden*, Sept. 1897 (isotype of *Gloeocapsa calcarea* in Tild. Amer. Alg. 299, FM). BURMA: auf bloßer Erde, Thabyaegon, *S. Kurz* (isotype of *Chroococcus granulatus* in Rabenh. Alg. 2332, N).—F. DROUET AND W. A. DAILY.

*calcareo* Tild. Amer. Alg. 3: 299. 1898.—On wet objects and in shallow fresh or brackish water, well represented in the collections from springs at lower temperatures, NEVADA: Washoe county: in a cold pool, Steamboat springs, *Groesbeck* 293, Nov. 1940. CALIFORNIA: Mono county: cold and warm pools and springs at the travertine quarry, Bridgeport, *Groesbeck* 42, 101, 257, 342, 469, 1940–41; under ice in pool in side of cliff, Hot creek geysers, *Groesbeck* 206, Nov. 1940. Inyo county: with *Aphanocapsa Grevillei* on rock, the Geysers, *Groesbeck* 140, Sept. 1940; culture from Bad Water, Death valley, *Holman & Bonar* 7799, Apr. 1933; cold alkaline stream, Gnome's Workshop, Death valley, *Groesbeck* 295, Jan. 1941; Nevares spring near Cow creek, Death valley, *Munz* 2280.5, Apr. 1937.

CHROOCOCCUS TURGIDUS (Kutz.) Näg. Gatt. einz. Alg. 46. 1848. *Protococcus turgidus* Kütz. Tab. Phyc. 1: 5. 1846. *Pleurococcus turgidus* Trev. Sagg. Monogr. Alg. Coccot. 34. 1848. *Chroococcus turgidus* var. *rufescens* Wartm. in Rabenh. Alg. 63 & 64: 631. 1857. *C. thermophilus* Wood Amer. Journ. Sci. ser. 2, 46: 34. 1868.—In shallow fresh or brackish, cold or warm water, often seen mixed with other algae on wet objects. The type collection of *C. thermophilus* Wood contains plants similar to those of other collections listed here. CALIFORNIA: Mono county: in outlet of a hot spring and in a large warm pool, travertine quarry near Bridgeport, *Groesbeck* 46, 101, Apr., June 1940; hot spring, Benton, *Mrs. Partz*, Aug. 1866 (TYPE of *C. thermophilus* in Acad. Nat. Sci. Phila.; isotype, FM). Inyo county: tepid stagnant water, Keough hot springs, *Groesbeck* 399, July 1941, idem with *Lyngbya aestuarii* in a cold stream, 230, Nov. 1940; first spring south of Triangle spring, Death valley, *Grinnell* 7626, Oct. 1933; in tepid spring, Furnace creek wash, Death valley, *Groesbeck* 298, Jan. 1941; cold alkaline spring, Gnome's Workshop, Death valley, *Groesbeck* 215, Oct. 1940, idem with *C. rufescens*, 295, Jan. 1941. San Bernardino county: Waterman hot springs, *Setchell* 1554a, Dec. 1896.

PLEUROCAPSA VARIA (A. Br.) Drouet & Daily in Daily Amer. Midl. Nat. 27: 644, f. 36, 39. 1942. *Chroococcus varius* A. Br. in Rabenh. Alg. 246–248: 2451. 1876; in Wittr. & Nordst. Alg. exs. 12: 600. 1883; Hansg. Prodr. 2: 164. 1892. *Chroococcus cohaerens* Näg. in Rabenh. Alg. 45 & 46: 446. 1855 [not Näg. Gatt. einz. Alg. 46. 1848]. *C. decolorans* Mig. Crypt. Germ. Austr. & Helv. exs. 26 & 27 (Algen): 83. 1906.—On rocks and wood in wet places, often in shallow running water. CALIFORNIA: Mono county: in outflow

of pool, travertine quarry at Bridgeport, *Groesbeck* 256, Nov. 1940; warm pool in weeds by Hot creek, *Groesbeck* 202, Nov. 1940.

ANACYSTIS MARGINATA Menegh. Consp. Fl. Eugean. 6. 1837; Daily Amer. Midl. Nat. 27: 649, f. 28. 1942. *Palmella marginata* Kütz. Phyc. gener. 172. 1843. *Microcystis marginata* Kütz. Tab. Phyc. 1: 6. 1846. *Palmella Castagnei* Kütz.<sup>1</sup> *ibid.* 1: 1846. *Onco-byrsa Castagnei* Bréb. in Kütz. pro synon., loc. cit. 1846. *Cagniardia Castagnei* Trev. Sagg. Monogr. Alg. Coccot. 51. 1848. *Aphanocapsa Castagnei* Rabenh. Fl. Eur. Alg. 2: 50. 1865. *Aphanothece Castagnei* Rabenh. *ibid.* 2: 64. 1865. *Polycystis marginata* Richt. Hedwigia 1885: 20. 1885. *Aphanothece conferta* Richt. in Hauck & Richt. Phyk. univ. 10: 487. 1892.—Subaerial and in shallow fresh water, both hot and cold. Specimens seen, CALIFORNIA: on stems in a cold pool, travertine quarry near Bridgeport, *Groesbeck* 42, 265, Apr. and Nov. 1940; in a small hot spring and around a vent actively spitting drops of boiling water, Hot creek geysers, *Groesbeck* 61, 418, June 1940, July 1941; Benton hot springs, *Duran* 7797, Apr. 1935.

ANACYSTIS RUPESTRIS (Lyngb.) Drouet & Daily<sup>2</sup> in Daily Amer. Midl. Nat. 27: 650, f. 19, 26. 1942. *Palmella rupestris* Lyngb. Tent. Hydrophyt. Dan. 207. 1819. *Microcystis rupestris* Kütz. Linnaea 8: 374. 1833. *Microhaloa rupestris* Kütz. Phyc. gener. 169. 1843. *Gloeocapsa tepidarium* A. Br. in Rabenh. Alg. 23 & 24: 221. 1852. *Gloeothece distans* Stizenb. in Rabenh. Alg. 97 & 98: 971. 1860. *Aphanothece Naegeli* Wartm. in Rabenh. Alg. 109 & 110: 1093. 1861. *Gloeothece tepidarium* Lagerh. Öfv. Kgl. Vet.-Akad. Förh.

<sup>1</sup>Original specimens of *Palmella Castagnei*, FRANCE: Aix, Provence, ex herb. Lenormand (isotype?, FM); dans l'étang de la Valduc, *Castagne* (Desmaz. Pl. Crypt. Fr. 4955, N), are similar in structure to those of *Anacystis marginata* Menegh. The same is true of original material of *Aphanothece conferta* Richt., SAXONY: Oschatz, in einem Gewächshause in Kalkwänden, *E. May*, Feb. 1892 (Hauck & Richt. Phyk. univ. 487, F).—F. DROUET AND W. A. DAILY.

<sup>2</sup>Not having seen the original specimens of *Palmella rupestris* Lyngb., we have followed the interpretation of Ed. Bornet, as shown in specimens labeled by him in the Farlow Herbarium. Similar to these are the following specimens, the bases for other names listed here as synonyms: BRANDENBURG: in Warmhaus des Universitätsgarten, Berlin, *A. Braun*, Oct. 1875 (original material of *Gloeothece decipiens* in Rabenh. Alg. 2456, FM, N), *idem* Dec. 1875 (isotype of *Aphanocapsa biformis* in Rabenh. Alg. 2453b, F), *idem* Berliner bot. Garten, Apr. 1875 (original material of *Gloeothece decipiens* in Rabenh. Alg. 2456b, FM, N); im Warmhaus des Geheimen Oberhofbuchdruckers Decker, Berlin, *A. Braun*, Juli & Okt. 1852 (isotype of *Gloeocapsa tepidarium* in Rabenh. Alg. 221, FM). BADEN: Konstanz in Torftümpeln, *E. Stizenberger*, Apr. 1860 (isotype of *Gloeothece distans* in Rabenh. Alg. 971, FM). SWITZERLAND: Zweibrücker-Tabel bei St. Gallen, *Wartmann*, Juli 1860 (isotype of *Aphanothece Naegeli* in Rabenh. Alg. 1093, FM, N). PUERTO RICO: on a water-pipe near a stream, *Maricao*, *N. Wille* 1147, Feb. 1915 (isotype of *Aphanothece conferta* var. *brevis*, D). CHINA: Fulung hot springs, Fukien province, *H. H. Chung* A439, Sept. 1926 (isotype of *Aphanothece gelatinosa*, D).—F. DROUET AND W. A. DAILY.

Stockholm 40 (2): 44. 1883. *Gloeotheca decipiens* A. Br. apud Richt. in Wittr. & Nordst. Alg. exs. 13: 594. 1883. *Aphanocapsa biformis* A. Br. apud Richt. in Wittr. & Nordst. ibid. 12: 600. 1883. *Gloeotheca rupestris* Born. pro synon. Mém. Soc. Nat. Cherbourg 28: 177. 1892; Hansg. Prodr. 2: 136. 1892. *G. rupestris* var. *tepidariorum* Hansg. loc. cit. 1892. *Aphanothece conferta* var. *brevis* Gardn. Mem. New York Bot. Gard. 7: 4. 1927. *A. gelatinosa* Gardn. Univ. Calif. Publ. Bot. 14: 2. 1927.—A cosmopolitan species, chiefly growing on moist soil and rocks, often found in shallow water. Specimens seen, CALIFORNIA: Inyo county: Nevares spring near Cow creek, Death valley, *Hollenberg 2279*, Apr. 1937 (D). San Bernardino county: Arrowhead hot springs, *Setchell 1539, 1545*, Dec. 1896, *Gardner 17, 18*, May 1930. Riverside county: in crevice of dripping rocks, Palm canyon near Palm Springs, *Hollenberg 1632*, Mar. 1935 (D).

ANACYSTIS PENIOCYSTIS (Kütz.) Drouet & Daily in Daily Amer. Midl. Nat. 27: 651. f. 29, 35, 38. 1942. *Gloeocapsa Peniocyctis* Kütz.<sup>1</sup> Tab. Phyc. 1: 25. 1847. *Peniocyctis purpurea* Bréb. in Kütz. pro synon. loc. cit. 1847. *Gloeocapsa purpurea* Kütz. ibid. 1: 18. 1847.—In shallow warm or cold fresh water, or with other algae on wet rocks and wood. As Daily (op. cit.) has pointed out, this alga passes under the name *Gloeotheca linearis* Näg. in recent literature. Specimens seen, NEVADA: Washoe county: small basin in calcareous deposit and small tepid pool, Steamboat, *Groesbeck 114, 192*, June, Sept. 1940. CALIFORNIA: Mono county: on stems in a large cold spring and on side of a large cold pool at the travertine quarry near Bridgeport, *Groesbeck 175, 472*, Sept. 1940, July 1941; with *Spirulina labyrinthiformis* in a cold pool, Hot creek geysers, *Groesbeck 417*, July 1941. San Bernardino county: in a hot water creek, Arrowhead hot springs, *Parks 3250*, Dec. 1929.

COELOSPHAERIUM KUETZINGIANUM Näg. Gatt. einz. Alg. 54, Tab. 1C. 1848; Daily Amer. Midl. Nat. 27: 654, f. 23. 1942. C.

<sup>1</sup>For authentic material of *Gloeocapsa Peniocyctis* Kütz. we have accepted here a specimen in the cryptogamic herbarium of Field Museum from Arromanches, Calvados, labeled *Peniocyctis purpurea* by A. de Brébisson. Although Kütz. (loc. cit.) says that the type comes from Falaise he records elsewhere in the same publication the occurrence of *G. Peniocyctis* with *G. purpurea* from Arromanches. Moreover, as can be seen in the first sentence in the footnote under *Chroococcus rufescens* above, there is no assurance that Brébisson's "Falaise" refers in every instance to the town of that name or to swamps in the vicinity of Arromanches. Similar material from Arromanches by Brébisson is distributed under the name *G. purpurea* in Rabenh. Alg. 1596 (FM, N). The chroococcaceous forms in these two collections described by Kütz. as *G. Peniocyctis* and *G. purpurea* are interpreted here as growth-forms of a single species.—F. DROUET AND W. A. DAILY.

*Naegelianum* Ung.<sup>1</sup> Denkschr. k. Akad. Wiss. math.-naturw. Kl. Wien 7: 195, f. 8. 1854. *C. Wichurae* Hilse in Rabenh. Alg. 153 & 154: 1523. 1863. *Hydroepicoccum genuense* de Not. Hedwigia 1869: 86. 1869. *Coelosphaerium genuense* de Not. in Ard. & Straff. Enum. Alg. Lig. 61. 1877.—Planktonic in bodies of fresh water and developing as waterbloom. Specimens seen, CALIFORNIA: San Bernardino county; Big Bear lake, *Hollenberg* 469, Aug. 1934 (D), idem 1624 (FM).

GOMPHOSPHERA APONINA Kütz. Alg. exs. Dec. 16: 151. 1836; Daily Amer. Midl. Nat. 27: 665, f. 20, 21. 1942. *G. apoina* var. *cordiformis* Wolle in Wittr. & Nordst. Alg. exs. 10: 498. 1882.—In shallow fresh and brackish water, often found mixed with other algae on wet rocks etc. Specimens seen, CALIFORNIA: Mono county: in a large warm pool and in the cold part of the run-off from a very hot spring, travertine quarry near Bridgeport, *Groesbeck* 101, 161, June, Sept. 1940; with *Phormidium laminosum* in a hot pool, Hot creek geysers, *Groesbeck* 407, July 1941. Inyo county: alkaline pool, Bad Water, Death valley, *Holman & Bonar* 7213, Apr. 1933, *Groesbeck* 1, 217, 303, Feb., Oct. 1940, Jan. 1941.

### Chamaesiphonaceae

DERMOCARPA HOLLENBERGII Drouet, Field Mus. Bot. Ser. 20: 129. 1942.—One specimen, the type, CALIFORNIA: San Bernardino county: attached to *Rhizoclonium* in small pond at Old Woman springs, Mojave desert, *Hollenberg* 2084, May 1937 (D).

<sup>1</sup>Limnological literature is crowded with speculations about what the names *C. Kuetzingianum* Näg. and *C. Naegelianum* Ung. refer to. Having had access to the original specimens of neither, we are not prepared to offer material evidence to support a contention that Nägeli and Unger were describing the same species. But when we compare the original descriptions and figures, we find no mention of the presence or absence of pseudovacuoles (the word was not introduced until some decades later) nor illustrations of them; also we find no reference to differences in shapes of the protoplasts. It has been called to our attention that upon the basis of just these differences the two authors of important recent works on freshwater algae, Geitler in Rabenh. Krypt.-Fl. 14: 248–253 (1931) and Smith in Freshw. Alg. U. S. 66 (1933), have separated the two species; we find no evidence that the authors have examined the original specimens either. *C. Kuetzingianum*, according to both Geitler and Smith, is a plant with spherical protoplasts which contain no pseudovacuoles; the plants never develop *en masse* as heavy water-blooms but inhabit shallow water and are carried only fortuitously into the plankton. Students who employ these two publications apparently have difficulty in identifying plants with this description. Specimens of the coelosphaeroid growth-form of *Polycystis aeruginosa* Kütz. (with the pseudovacuoles lost before preservation or after long standing in formalin) and of *Coelosphaerium Collinsii* Drouet & Daily and *Gomphospheria lacustris* Chod. (both of which have elongated protoplasts) are popular for designation as *Coelosphaerium Kuetzingianum* in recent limnological literature. Specimens of the planktonic *C. Kuetzingianum* as described by Daily (loc. cit.) are the ones most frequently determined as *C. Naegelianum* according to Geitler's and Smith's keys and descriptions. In Nägeli's

DERMOCARPA GARDNERIANA Drouet *ibid.* 20: 128. 1942.—On rocks in shallow running water. One specimen, NEVADA: Washoe county: with *Calothrix parietina* in a cold stream, Steanboat, Groesbeck 447, July 1941.

DERMOCARPA SETCHELLII Drouet *ibid.* 20: 129. 1942.—Known only from the type collection, CALIFORNIA: San Bernardino county: Harlem hot springs, *Setchell* 1560, Dec. 1896.

CHAMAESIPHON POLONICUS (Rostaf.) Hansg. Prodr. Algenfl. Böhmen 2: 123. 1892. *Sphaerogonium polonicum* Rostaf. Rozpr. Akad. umiej. Kraków. 10: 299. 1883.—On stones and wood in streams, fountains, etc. One collection, NEVADA: Washoe county: in a drinking fountain in the park, Reno, *Drouet & Richards* 4112, Sept. 1941.

### Stigonemataceae

FISCHERELLA AMBIGUA (B. & F.) Gom. Journ. de Bot. 9: 52. 1895. *Scytonema ambiguum* Kütz. ex B. & F. Ann. Sci. nat. VII Bot. 5: 100. 1887. *S. badium* Wolle ex B. & F. *ibid.* 5: 111. 1887. *Phormidium interruptum* var. *rigidum* Gardn. Mem. N. Y. Bot. Gard. 7: 44. 1927. *Plectonema flexuosum* Gardn. *ibid.* 7: 47. 1927. *Scytonema tenue* Gardn.<sup>1</sup> *ibid.* 7: 78. 1927. *S. Gardneri* J. DeToni

description and figure of *C. Kuetzingianum* the protoplasts are represented as spherical; but even a careless observer will note that Nägeli's illustrations are as idealized and mechanically perfect as the superb logic of his arrangement of the "unicellular" algae—his spherical plants and protoplasts are perfect circles; his precise and symmetrical arrangement of cells in the plants could never be matched with actual specimens. Moreover, Nägeli describes the habitat as "Gräben," what might be called "ditches" in English; but it is conceivable to us that ditches may easily become filled with heavy waterblooms, especially if situated on the leeward side of a lake. In Unger's description and figure of *C. Naegelianum* we receive the impression of an organism exactly similar to Nägeli's *C. Kuetzingianum*, with spherical protoplasts and no pseudovacuoles, but the plants (not the protoplasts) larger and covered externally with hairs (bacteria?). The plants grew as a true waterbloom "im grossen Bassin des botanischen Gartens in Grätz." Can it be that the authors of the two manuals now in vogue have made an arbitrary distinction between the species solely on the basis of a literal interpretation of the words "Gräben" and "Bassin"? Less recent authors, as pointed out by Forti, Syll. Myxophyc. 100 (1907), have based their distinctions between *C. Kuetzingianum* and *C. Naegelianum* upon the size of the plants, as originally stated by Unger. Original specimens of other species listed here in synonymy were examined as follows, SILESIA: auf einem Teiche am Schlosse von Habendorf, Kr. Reichenbach, *Hilse*, Sept. 1862 (isotype of *Coelosphaerium Wichurae* in Rabenh. Alg. 1523, FM, N). ITALY: in aquariis horti botanici Genuensis, *de Notaris*, 1868–69 (isotype of *Hydroepicoccum genuense* in Rabenh. Alg. 2127, F, FM, N).—F. DROUET AND W. A. DAILY.

<sup>1</sup>Isotypic material of this species and of *S. Gardneri* J. DeToni, PUERTO RICO: on rocks by a reservoir, Rio Piedras, *Wille* 106, Dec. 1914, in the Herbarium of the University of California consists of plants typical in every respect of specimens of *Fischerella ambigua* cited by Gomont.

Noter. Nomencl. Algol. 1: 7. 1934.—On wet rocks and soil, subaerial or aerial. Specimens seen, CALIFORNIA: San Bernardino county: Arrowhead hot springs, *Gardner* 5, 15, May 1930.

HAPALOSIPHON PUMILUS (Kütz.) Kirchn. ex B. & F. *ibid.* 5: 61. 1887. *H. fontinalis* (Ag.) Born. Bull. Soc. Bot. Fr. 36: 156. 1889. *H. brasiliensis* Borge Ark. f. Bot. 15 (13): 94. 1919.—In fresh water. The one specimen referred here is incrustated with lime, and for this reason the filaments exhibit certain peculiarities of growth. *H. pumilus* appears rarely in general collections of algae from western North America. CALIFORNIA: Inyo county: on sides of a wood flume about 1 mile east of Furnace Creek inn, Death valley, *Groesbeck* 16, Feb. 1940.

HAPALOSIPHON LAMINOSUS (Kütz.) Hansg. ex B. & F. *ibid.* 5: 55. 1887. *Nostoc caladarium* Wood ex B. & F. (as sp. inquir.) *ibid.* 7: 221. 1888; Wood Amer. Journ. Sci. ser. 2, 46: 33. 1868. *Hapalosiphon major* Tild. Amer. Alg. 2: 167. 1896.—In shallow water and on wet substrata in and about hot springs. Temperatures of the water from which the collections below were taken range from cold to 150° F., the greater number in the vicinity of 120° F. Bornet & Flahault (*loc. cit.*) and more recently Boye Petersen in Bot. Icel. 2 (2): 307ff. (1928) have reviewed the voluminous literature on this species and have pointed out the diversity of forms assumed by the filaments under various conditions of growth. Specimens seen, NEVADA: Washoe county: in the run-off of the largest spring and below a leaking pipe from a hot tank, Steamboat, *Groesbeck* 110, 377, June 1940, Apr. 1941. CALIFORNIA: Modoc county: hot springs in southwestern part of county, *Hall & Babcock*, June 1903. Mono county: in hot springs, streams, and spray, Fales hot springs, *Groesbeck* 26, 186, 189, 356, 1940–41; hot springs in the travertine quarry near Bridgeport, *Groesbeck* 179, 462, Sept. 1940, July 1941; Benton hot springs, *Mrs. Partz*, Aug. 1866 (TYPE of *Nostoc caladarium* in the Academy of Natural Sciences, Philadelphia; isotype, FM), *Duran* 7795, Apr. 1935; around steam vent, Paoha island, Mono lake, *Groesbeck* 86, June 1940. Inyo county: mouth of a steaming vent, the Geysers, *Groesbeck* 136, Sept. 1940; in a hot spring and in the basins of the hydraulic ram and the pump-pit, Keough hot springs, *Groesbeck* 69, 147, 225, 313, 394, 1940–41. San Bernardino county: Waterman hot springs, *Setchell* 1552, Dec. 1896; Arrowhead hot springs, *Setchell* 1543, 1854, Dec. 1896, Apr. 1898 (Phyc. Bor.-amer. 858, FM), *Gardner* 7795a, June 1929, *Parks* 3245a, Dec. 1929, *Gardner* 20, 24, 25, May 1930.

## Nostocaceae

NOSTOC LINCKIA (Roth) Born. ex B. & F. Ann. Sci. Nat. VII Bot. 7: 192. 1888.—In shallow fresh water. Specimens seen, CALIFORNIA: Modoc county: in north fork of Pit river, Alturas, *Drouet & Richards* 4148, 4172, Sept. 1941. Mono county: on the sides of a cool spring, Fales hot springs, *Groesbeck* 355, Apr. 1941; in a spring in the travertine quarry, Bridgeport, *Groesbeck* 458, July 1941. Inyo county: with *N. spongiiforme* in cold water, Little lake, *Groesbeck* 149, Sept. 1940.

NOSTOC CARNEUM (Lyngb.) Ag. ex B. & F. *ibid.* 7: 196. 1888.—In shallow fresh water. Specimens seen, CALIFORNIA: Modoc county: in sloughs and in north fork of Pit river, Alturas, *Drouet & Richards* 4136, 4140, 4164, Sept. 1941. Inyo county: Little lake, *Groesbeck* 222, Nov. 1940. San Bernardino county: Harlem hot springs, *Setchell* 1558, Dec. 1896.

NOSTOC RIVULARE Kütz. ex B. & F. *ibid.* 7: 195. 1888.—In shallow fresh water. One collection, CALIFORNIA: Modoc county: north fork of Pit river, Alturas, *Drouet & Richards* 4152, Sept. 1941.

NOSTOC SPONGIIFORME Ag. ex B. & F. *ibid.* 7: 197. 1888.—In shallow fresh water. Specimens seen, CALIFORNIA: Inyo county: Little lake, *Groesbeck* 149, Sept. 1940. San Bernardino county: in water along upper trail, Arrowhead hot springs, *Gardner* 21, May 1930.

NOSTOC ELLIPSOSPORUM (Desmaz.) Rabenh. ex B. & F. *ibid.* 7: 198. 1888.—On wet rocks and soil. One specimen, CALIFORNIA: Riverside county: Palm canyon near Palm Springs, *Hollenberg* 1613, Mar. 1935.

NOSTOC MUSCORUM Ag. ex B. & F. *ibid.* 7: 200. 1888. - In wet ground, developing most conspicuously on mud along streams and in depressions exposed to the sun. Specimens seen: CALIFORNIA: Modoc county: on mud along the north fork of Pit river, Alturas, *Drouet & Richards* 4146, 4158, 4165, 4166, 4168, 4169, 4188, Sept. 1941; on mud beside an irrigation ditch in the hills 2 miles northwest of Alturas, *Drouet & Richards* 4115, 4117, 4131a, Sept. 1941. San Bernardino county: in a depression near Mountain Spring camp northeast of Essex, *Drouet & Macbride* 4613, Oct. 1941; along an intermittent stream 10 miles northwest of Vidal, *Drouet & Macbride* 4668, Oct. 1941. Imperial county: on moist ground along irrigation ditches between Brawley and Imperial, *Drouet & Macbride* 4816, 4819, Oct. 1941; in a ditch just east of Heber, *Drouet & Macbride*



4811, Oct. 1941. ARIZONA: on an alluvial flat by Colorado river below the old Spanish fort, Yuma, *Drouet* 3444, Dec. 1939.

NOSTOC COMMUNE Vauch. ex B. & F. *ibid.* 7: 203. 1888.—On wet or dry open ground, seldom seen in intermittent pools. Two collections, CALIFORNIA: Modoc county: on mud in sloughs along north fork of Pit river, Alturas, *Drouet & Richards* 4157, 4167, Sept. 1941.

NOSTOC SPHAERICUM Vauch. ex B. & F. *ibid.* 7: 208. 1888.—On rocks, wood, and other objects in flowing fresh water, chiefly in streams. Specimens seen, CALIFORNIA: Inyo county: on grass stems in a stream between highly alkaline pools beside railroad 1 mile north of Shoshone, *Groesbeck* 21, Feb. 1940. Riverside county: on stones in Snow creek, north side of San Jacinto mountains, *Hollenberg* 1560, 4436, Apr., Sept. 1934 (D).

NOSTOC AMPLISSIMUM Setch. *Erythea* 7: 50, pl. 2, 3. 1899.—On stones on the bottom in flowing water of streams. Specimens seen, NEVADA: Humboldt county: Humboldt river, Winnemucca, *D. Griffiths*, July 1901 (as *N. verrucosum* in Tild. Amer. Alg. 583b, FM). Lincoln county: Vegas valley, *Coville & Funston* 391, 1891 (D, F). CALIFORNIA: Modoc county: on stones in north fork of Pit river, Alturas, *Drouet & Richards* 4134, Sept. 1941.

NOSTOC PARMELIODES Kütz. ex B. & F. *ibid.* 7: 219. 1888.—On stones in shallow flowing water of streams. Specimens seen, CALIFORNIA: San Bernardino county: in rapid stream, Bear valley, *Parish* 2308, June 1892 (C); on stones in stream, Camp La Verne, Jenks lake, *Hollenberg* 1559, May 1934 (D). Riverside county: in the stream in Tahquitz canyon near Palm Springs, *Drouet & Macbride* 4738, Oct. 1941.

ANABAENA VARIABILIS Kütz. ex B. & F. *ibid.* 7: 226. 1888.—In shallow fresh or slightly brackish water. Specimens seen, CALIFORNIA: Modoc county: in north fork of Pit river, Alturas, *Drouet & Richards* 4185, Sept. 1941. San Bernardino county: scum on ditch near Mentone, *Hollenberg* 3163, Feb. 1941.

ANABAENA INAEQUALIS (Kütz.) B. & F. *ibid.* 7: 231. 1888.—In shallow fresh water. One specimen, CALIFORNIA: Riverside county: in trickle from rocky side of Palm canyon, near Palm Springs, *Hollenberg* 1645, Mar. 1935.

ANABAENA CATENULA (Kütz.) B. & F. *ibid.* 7: 232. 1888.—In shallow fresh water. One collection, CALIFORNIA: Modoc county: north fork of Pit river, Alturas, *Drouet & Richards* 4187, Sept. 1941.

ANABAENA OSCILLARIOIDES Bory ex B. & F. *ibid.* 7: 233. 1888. - In shallow fresh water. In both collections cited here the spores are immature, CALIFORNIA: San Bernardino county: in seeping rivulet by roadside near Big Bear lake, *Hollenberg 1567a*, Aug. 1934; Big Bear lake, *Hollenberg 1644*, Aug. 1934.

CYLINDROSPERMUM MUSCICOLA Kütz. ex B. & F. *ibid.* 7: 254. 1888. *C. caeruleum* Dick. ex B. & F. *ibid.* 7: 255. 1888.—In wet ground, less often seen in shallow water. One collection, CALIFORNIA: Modoc county: with *Schizothrix purcellii* on wet ground in the hills 2 miles northwest of Alturas, *Drouet & Richards 4119*, Sept. 1941.

CYLINDROSPERMUM LICHENIFORME (Bory) Kütz. ex B. & F. *ibid.* 7: 253. 1888.—In wet ground and in shallow fresh water. Specimens seen, CALIFORNIA: Modoc county: on the shore of the north fork of Pit river, Alturas, *Drouet & Richards 4179*, Sept. 1941. Riverside county: on rocks in the stream in the lower part of Palm canyon near Palm Springs, *Drouet & Macbride 4731*, Oct. 1941.

CYLINDROSPERMUM MAJUS Kütz. ex B. & F. *ibid.* 7: 252. 1888. *C. janthinum* Dick. ex B. & F. *ibid.* 7: 255. 1888.—In wet ground and in shallow water. Specimens seen: CALIFORNIA: San Bernardino county: in Barton creek above Camp La Verne, San Bernardino mountains, *Hollenberg 1565*, Aug. 1935; in seeping rivulet by roadside near Big Bear lake, *Hollenberg 1567*, Aug. 1934.

NODULARIA HARVEYANA (Thw.) Thur. ex B. & F. *ibid.* 7: 243. 1888.—In shallow fresh and brackish water. Specimens seen, CALIFORNIA: Mono county: in a cool spring and with *Hydrocoleum Groesbeckianum* in a stream at the travertine quarry near Bridgeport, *Groesbeck 90, 271*, June, Nov. 1940. San Bernardino county: in the bed of a desiccated lake, Hinkley station, *Drouet & Macbride 4569*, Oct. 1941.

NODULARIA SPUMIGENA Mert. ex B. & F. *ibid.* 7: 245. 1888.--In fresh and brackish water, not uncommonly found in wet ground. One collection, CALIFORNIA: Modoc county: with *CylindrospERMUM licheniforme* on the shore of the north fork of Pit river, Alturas, *Drouet & Richards 4179*, Sept. 1941.

### Rivulariaceae

AMPHITHRIX JANTHINA (Mont.) B. & F. *Ann. Sci. Nat. VII Bot.* 3: 344. 1886. *Inactis ealcarea* Gardn.<sup>1</sup> *Mem. N. Y. Bot. Gard.* 7:

<sup>1</sup>See footnote, p. 158.

54. 1927. *Schizothrix rhodochlamys* Lillick<sup>1</sup> Rév. Algol. 9 (1): 141. 1937.—On rocks, wood, etc. in flowing fresh water. Specimens seen, NEVADA: Washoe county: in a drinking fountain in the park, Reno, *Drouet & Richards* 4112, Sept. 1941; in a cold stream, Steamboat, *Groesbeck* 294, Nov. 1940. CALIFORNIA: Mono county: in a cold stream in the travertine quarry near Bridgeport, *Groesbeck* 103, June 1940. Inyo county: on wood in Little lake, *Groesbeck* 155, 381, Sept. 1940, July 1941; on *Ruppia* in a salt pool, Death valley, *Groesbeck* 216, Oct. 1940.

CALOTHRIX BRAUNII B. & F. *ibid.* 3: 368. 1886. *Inactis obscura* Dick. ex Gom. *idem* 15: 329. 1892.—On rocks, etc., usually in flowing fresh water. Specimens seen, CALIFORNIA: Inyo county: on dead plant stems in shallow water of a small cold lake just south of Lone Pine, *Groesbeck* 79, June 1940. Riverside county: on rocks in the stream in Tahquitz canyon near Palm Springs, *Drouet & Macbride* 4745, Oct. 1941.

CALOTHRIX PARIETINA (Näg.) Thur. ex B. & F. *ibid.* 3: 366. 1886. *Mastigothrix turgida* Wolle ex Forti Syll. Myxophyc. 632. 1907.—Aerial, subaerial, and submersed in fresh water. Specimens seen, NEVADA: Washoe county: on the walls of a cool tank and on the ground about it, Steamboat, *Groesbeck* 191, 278, 376, 428, 429, 1940–41; in a small spring and a cold stream, Steamboat, *Groesbeck* 116, 194, 362, 447, 448, 1940–41. CALIFORNIA: Mono county: on a wet rock by the stream from the large spring, Fales hot springs, *Groesbeck* 188, Sept. 1940; floating and in crusts on plant-stems etc. in cold and tepid springs, pools, and bogs at the travertine quarry near Bridgeport, *Groesbeck* 42, 95, 248, 251, 269, 335, 344, 480, 483, 1940–41. Inyo county: on a stone and on submerged wood in Little lake, *Groesbeck* 224, 306, Nov. 1940, Apr. 1941. Riverside county: on rocks in the stream in the lower part of Palm canyon near Palm Springs, *Drouet & Macbride* 4730, Oct. 1941.

CALOTHRIX ADSCENDENS (Näg.) Thur. ex B. & F. *ibid.* 3: 365. 1886. *C. violacea* (Wolle) Forti Syll. Myxophyc. 619, 1907. *Mastigonema violaceum* Wolle ex Forti loc. cit. 1907. *M. fuscum* Wolle ex Forti *ibid.* 618. 1907. *Calothrix Fortii* J. DeToni Noter. Nomencl. Algol. 1: 6. 1934.—Growing attached to larger plants in fresh water. One specimen, CALIFORNIA: Mono county: on plant-stems in a

<sup>1</sup> Isotypic specimens of *Inactis ecalcareae* Gardn. [PUERTO RICO: on stones in Turabo river, Caguas, *N. Wille* 481a, Jan. 1915 (C)] and *Schizothrix rhodochlamys* Lillick [OHIO: stream east of Cincinnati, *W. H. Buchler*, 1932 (D)] appear to be typical *Amphithrix janthina*.

large cold spring at the travertine quarry, Bridgeport, *Groesbeck* 341, Apr. 1941.

*CALOTHRIX THERMALIS* (Schwabe) Hansg. ex B. & F. *ibid.* 3: 368. 1886.—In shallow water and on wet rocks in and about hot springs. Specimens seen, CALIFORNIA: Mono county: in a pool and in the overflow from the end of a travertine ridge at the travertine quarry near Bridgeport, *Groesbeck* 41, 463, Apr. 1940, July 1941. San Bernardino county: Arrowhead hot springs, *Parks* 3247b, Dec. 1929, *Setchell* 1536, 1542, 1546, Dec. 1896; Waterman hot springs, *Setchell* 1552, 1556, 1557, Dec. 1896.

*DICHOTHRIX inyoensis*, *sp. nov.* Stratum fuscum et fusco-aerugineum late expansum, calce plus minusve incrustatum, filis saepe penicillato-caespitosis longis gracilibus, basin usque ad 60  $\mu$  crassis, superne ramosis, pseudoramis ultimis usque ad 50  $\mu$  crassis; vaginis cylindraceis crassis gelatinosis uniformiter lamellosis, ad apices primum hyalinis, inferiore luteis vel fuscis; trichomatibus (in mediis partibus pseudoramarum ultimorum) usque ad 25  $\mu$  crassis, cylindraceis, superne in pilum longiorem attenuatis; articulis primum brevibus demum subquadratis vel diametro usque ad 3-plo longioribus; heterocystis basalibus sphaericis vel subsphaericis, heterocystis intercalariis cylindraceis.—This new species is similar in many respects to *D. Hosfordii* (B. & F.) Born.; it differs from the latter mainly in its longer and more robust filaments, which have the general appearance of those of *Scytonema Myochrous* B. & F. Occasionally scytonematoid branching is found in the filaments. One specimen, CALIFORNIA: Inyo county: in a very shallow pool in a salt playa on the floor of Death valley 35.7 miles south of Furnace creek on the east highway, *Groesbeck* 3, Feb. 1940 (TYPE in the Cryptogamic Herbarium, Field Museum).

*DICHOTHRIX ORSINIANA* (Kütz.) B. & F. *ibid.* 3: 376. 1886. On wet rocks etc. Specimens seen, CALIFORNIA: San Bernardino county: Arrowhead hot springs, *Setchell* 1538, Dec. 1896; on spray-covered rocks, Manker flats, Mount Baldy, *M. Stewart*, Oct. 1934.

*DICHOTHRIX GYPSOPHILA* (Kütz.) B. & F. *ibid.* 3: 377. 1886.—On wet substrata in fresh water. Specimens seen, CALIFORNIA: Inyo county: Death valley, *Parish* (C). San Bernardino county: on spray-covered cliffs at falls, Manker flats, Mount Baldy, *Hollenberg* 1612, Apr. 1934. Riverside county: on wet rocks in Palm canyon near Palm Springs, *Hollenberg* 1640, Mar. 1935.

*RIVULARIA HAEMATITES* (DC.) Ag. ex B. & F. *ibid.* 4: 350. 1886. *Dichothrix calcarea* Tild.<sup>1</sup> *Amer. Alg.* 2: 165. 1896. *Lyngbya Mar-*

*tensiana* var. *calcarea* Tild.<sup>1</sup> *ibid.* 2: 178. 1896.—On rocks and other substrata in fresh water. One specimen, CALIFORNIA: Inyo county: in a cold pool beside the railroad 1 mile north of Shoshone, *Groesbeck* 20, Feb. 1940.

GLOEOTRICHIA NATANS (Hedw.) Rabenh. ex B. & F. *ibid.* 4: 369. 1886. *Rivularia natans* (Hedw.) Welw. ex B. & F. loc. cit. 1886. *Calothrix scytonemicola* var. *brasiliensis* Borge Ark. f. Bot. 19 (17): 5. 1925. *Rivularia* (*Gloeothrichia*) *flagelliformis* Gardn. Mem. N. Y. Bot. Gard. 7: 71. 1927.—In shallow fresh water. Specimens seen, CALIFORNIA: Modoc county: in sloughs along the north fork of Pit river, Alturas, *Drouet & Richards* 4159, Sept. 1941. Inyo county: in Little lake, *Groesbeck* 151a, Sept. 1940.

### Scytonemataceae

FREMYELLA DIPLOSIPHON (B. & F.) Drouet Field Mus. Bot. Ser. 20: 32. 1939. *Microchaete diplosiphon* Gom. ex B. & F. Ann. Sci. Nat. VII Bot. 5: 84. 1887.—With other algae in strata in small more or less permanent bodies of water. It is possibly a growth-form of *Calothrix parietina* B. & F. One specimen, CALIFORNIA: Mono county: in a small cold pool in the travertine quarry near Bridgeport, *Groesbeck* 43, Apr. 1940.

AULOSIRA IMPLEXA B. & F. *ibid.* 7: 257. 1888. *Microchaete tenera* var. *tenuior* Gardn.<sup>2</sup> Mem. N. Y. Bot. Gard. 7: 71. 1927. *Fremyella tenera* var. *tenuior* J. DeToni<sup>2</sup> Archivio Bot. 15: 290. 1939.—In shallow fresh water. Specimens seen, CALIFORNIA: Inyo county: in a warm spring up Furnace creek wash about 1 mile from the hotel, Death valley, *Grinnell* 7622, Oct. 1933. San Bernardino county: Arrowhead hot springs, *Setchell* 1544, Dec. 1896, *Parks* 3248, Dec. 1929.

SCYTONEMA MYOCHROUS (Dillw.) Ag. ex B. & F. *ibid.* 5: 104. 1887.—On wet rocks, less often seen in very shallow fresh water. One collection, CALIFORNIA: San Bernardino county: in spray of falls, Manker flats near Mount Baldy, *Hollenberg* 1657, Apr. 1934.

SCYTONEMA FIGURATUM Ag. ex B. & F. *ibid.* 5: 101. 1887. *S. mirabile* (Ag.) Born. Bull. Soc. Bot. Fr. 36: 155. 1889 [not Wolle].

<sup>1</sup> Presumably isotypic material of *Dichothrix calcarea* and *Lyngbya Martensiana* var. *calcareo*, MINNESOTA: on sides of old wooden tank, Minneapolis, *J. E. Tilden*, Oct. 1895 (*Tild. Amer. Alg.* 165, 178, FM), is typical *Rivularia haematites*.

<sup>2</sup> The isotype of this variety in the Herbarium of the University of California, PUERTO RICO: among hepaticae by the road near Adjuntas, *N. Wille* 1571, Mar. 1915, contains underdeveloped filaments of *Aulosira implexa*.

*S. caldarium* Setch. Erythea 7: 48, pl. 3, f. 3. 1899. *S. pulchellum* Gardn.<sup>1</sup> Mem. N. Y. Bot. Gard. 7: 76. 1927. *S. guyanense* var. *minus* Gardn.<sup>1</sup> *ibid.* 7: 79. 1927. *S. multiramosum* Gardn.<sup>1</sup> *ibid.* 7: 81. 1927.—On wet substrata and in fresh water. Study of considerable amounts of the type material in the Herbarium of the University of California and in the Cryptogamic Herbarium of Field Museum shows that *S. caldarium* should more properly be considered a synonym of *S. figuratum* than of *S. stuposum* B. & F., as I proposed in Field Mus. Bot. Ser. 20: 38 (1939). The sheaths are chiefly colorless and thin, but they exhibit the irregular thickening behind the apices which is characteristic of those of *S. figuratum*. Specimens seen, CALIFORNIA: Inyo county: Nevares spring near Cow creek, Death valley, *Muncz* 2280, Apr. 1937 (D). San Bernardino county: Waterman hot springs, *Parish*, Apr. 1897 (TYPE of *S. caldarium* in herb. Univ. Calif.; isotypes in Phyc. Bor.-amer. 559), *Setchell* 1554, Dec. 1896; Arrowhead hot springs, *Parks* 3248a, Dec. 1929, *Gardner* 22, 26, May 1930.

SCYTONEMA TOLYPOTRICHOIDES Kütz. ex B. & F. *ibid.* 5: 100. 1887.—In shallow fresh water. Specimens seen, CALIFORNIA: San Bernardino county: Arrowhead hot springs, *Setchell* 1537, Dec. 1896, *Gardner* 12, 13, 51, May 1930; Waterman hot springs, *Setchell* 1549, Dec. 1896.

SCYTONEMA OCELLATUM Lyngb. ex B. & F. *ibid.* 5: 95. 1887. *S. ocellatum* var. *constrictum* Gardn.<sup>2</sup> Mem. N. Y. Bot. Gard. 7: 79. 1927. *S. spirulinoides* Gardn.<sup>2</sup> *ibid.* 7: 80. 1927. *S. tenellum* Gardn.<sup>2</sup> *loc. cit.* 1927.—On soil, rocks, and trees wet periodically by rains. Specimens seen, CALIFORNIA: San Bernardino county: in open ground in a ravine just east of South pass 12 miles west of Needles, *Drouet & Macbride* 4604, Oct. 1941. Riverside county: in barren ground in open scrub-forest near Desert Center, *Drouet & Macbride* 4710, 4718, west of Shavers Summit, *Drouet & Macbride* 4701, Oct. 1941. Imperial county: in barren spots in an open field at the south edge of Brawley, *Drouet & Macbride* 4775, Oct. 1941.

<sup>1</sup> Gardner's isotypes of *S. pulchellum* (on rocks near Utuado, *N. Wille* 1574, Mar. 1915), *S. guyanense* var. *minus* (between Arecibo and Utuado, *Wille* 1455), and *S. multiramosum* (10 km. north of Utuado, *Wille* 1527, Mar. 1915) from Puerto Rico in the Herbarium of the University of California appear to be easily recognizable specimens of *S. figuratum*.

<sup>2</sup> Gardner's isotypes of *S. ocellatum* var. *constrictum* (on rocks by the road north of Maricao, *Wille* 1253, Feb. 1915), *S. spirulinoides* (on rocks along the road, Coamo to San Lorenzo, *Wille* 534, Jan. 1915), and *S. tenellum* (north of Sabana Grande, *Wille* 936a) from Puerto Rico in the Herbarium of the University of California are all typical specimens of *S. ocellatum* B. & F.

SCYTONEMA HOFMANNII Ag. ex B. & F. *ibid.* 5: 97. 1887. *S. cortex* f. *corrugatum* Wolle F. W. Alg. U. S. 257. 1887. *S. cortex* f. *brunneum* Wolle *ibid.* 258. 1887. *S. Hofmannii* f. *brunneum* Wolle apud Forti Syll. Myxophyc. 515. 1907. *S. subgelatinosum* Gardn.<sup>1</sup> Mem. N. Y. Bot. Gard. 7: 74. 1927.—On rocks, soil, and other substrata kept wet with fresh water permanently or during the greater part of the year. Specimens seen, CALIFORNIA: San Bernardino county: on the wall of a hot tank north of the hotel, Arrowhead hot springs, *Gardner* 3, May 1930. Riverside county: on mud on the shore of the Colorado river 10 miles south of Vidal, *Drouet & Macbride* 4646, Oct. 1941.

SCYTONEMA STUPOSUM Born. ex B. & F. *ibid.* 5: 92. 1887. *S. occidentale* Setch.<sup>2</sup> Erythea 7: 49, pl. 3, f. 4. 1899. *S. azureum* Tild. Amer. Alg. 7: 630. 1909.—On rocks etc. kept wet with fresh water during the greater part of the year. Specimens seen, CALIFORNIA: San Bernardino county: Arrowhead hot springs, *Setchell* 1541, Dec. 1896. Imperial county: on stones in Snow creek, San Jacinto mountains, *Hollenberg* 1658, 1934.

### Oscillatoriaceae

PORPHYROSIPHON FUSCUS Gom. apud Frémy Bull. Mus. Hist. Nat. Paris 33: 115. 1927.—On soil wet occasionally by rains, most frequently seen in this region on soil in crevices of rocks. Specimens seen, CALIFORNIA: San Bernardino county: rocks near Needles, Essex, and Bagdad, *Drouet & Macbride* 4599, 4610, 4634a, on barren ground 10 miles northwest of Vidal, *Drouet & Macbride* 4665, Oct. 1941. Riverside county: rocks by Colorado river 10 miles south of Vidal, *Drouet & Macbride* 4658, barren ground west of Desert Center, *Drouet & Macbride* 4713, Oct. 1941.

SCHIZOTHRIX acutissima, *sp. nov.* Stratum pannosum friabile arenosum, aerugineum vel pallide roseum vel decoloratum, ad millimetrum crassum, filis passim elongatis intricatis sparse ramosis, passim brevibus atque fasciculato-ramosis; vaginis firmis hyalinis, aetate protracta luteis, primum arctis demum crassioribus et plus minusve gelatinosis, apice acutis, chlorozincico iodurato haud

<sup>1</sup> Isotypic material of *S. subgelatinosum* in the Herbarium of the University of California (PUERTO RICO: on rocks near a reservoir in Rio Piedras, *Wille* 108, Dec. 1914) contains a parasitized mass of *S. Hofmannii* in which the sheaths have become swollen.

<sup>2</sup> THE TYPE of *S. occidentale* in the Herbarium of the University of California (CALIFORNIA: La Jota falls near St. Helena, Napa county, *Setchell* 1095, Nov. 1895) appears to me to be similar to other specimens of *S. stuposum*.

caerulescentibus; trichomatibus aerugineis,  $4\ \mu$  ad  $6\ \mu$  crassis, intra vaginas basin pluribus supra solitariis vel duabus, cylindricis, ad genicula constrictis, ad apices longe et sensim attenuatis atque acuminatis; articulis subquadratis vel diametro usque duplo brevioribus, protoplasmate tenui-granuloso, dissepimentis non aut obscure granulatis; cellula apicali longe et acutissime conica.—Fig. 1. This species belongs in the Section Chromosiphon of Gomont near *S. Muelleri* Gom., from which it differs markedly in dimensions of

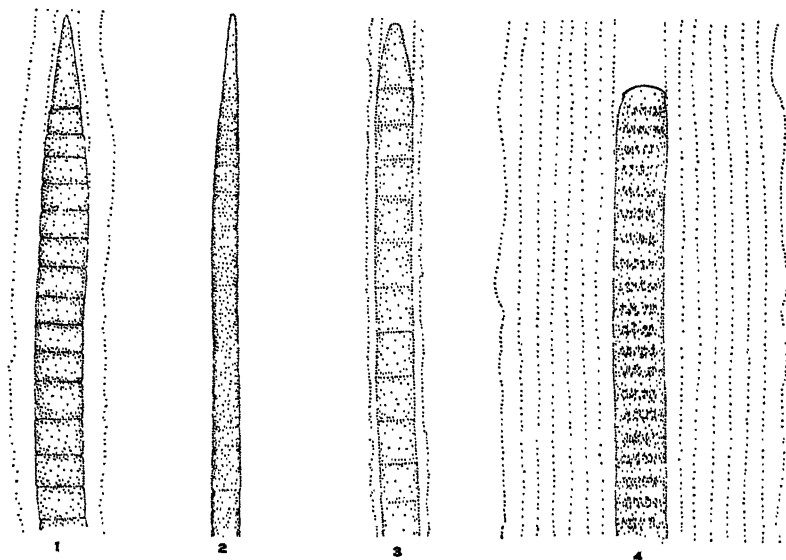


Fig. 1. *Schizothrix acutissima*. Fig. 2. *S. Macbridei*. Fig. 3. *S. californica*. Fig. 4. *Hydrocoleum Groesbeckianum*. Mature apices of the trichomes in these species as represented in the type specimens.

all parts, in the configuration of the apical cell, and in the general character of the sheath. It is a plant of sandy desert places, forming pannose strata with other vaginate myxophyceae in the slightest depressions on dunes and barren plains. The strata are usually impregnated with sand and silt. Specimens seen, COLORADO: Fremont county: in high red clay barrens along highway 115 about 20 miles northeast of Canon City, *Drouet & A. Cohen 4951*, July 1942. CALIFORNIA: San Bernardino county: on the plain near Piute station northeast of Essex, *Drouet & Macbride 4615*, along an intermittent stream 10 miles northwest of Vidal, *Drouet & Macbride 4667, 4770*, Oct. 1941. Imperial county: on sand dunes north of Mount Signal, *Drouet & Macbride 4798* (TYPE in Cryptogamic



Herbarium of Field Museum), on a sandy plain at Plaster City, *Drouet & Macbride 4794*, Oct. 1941. San Diego county: on a hillside west of Boulevard, *Drouet & Macbride 4837*, in open thickets at the south edge of Jacumba, *Drouet & Macbride 4847*, Oct. 1941.

*SCHIZOTHRIX MACBRIDEI* Drouet Amer. Midl. Nat. 29: 51. 1943.—Growing with other algae in thin crusts on silt in the slightest depressions in open ground in the deserts. Fig. 2. Specimens seen, CALIFORNIA: San Bernardino county: in rocky rolling ground near Mountain Spring camp northeast of Essex, *Drouet & Macbride 4614*, on black lava-flows east of Bagdad. *Drouet & Macbride 4636* (TYPE), on the alluvial bank of an intermittent stream 10 miles northwest of Vidal, *Drouet & Macbride 4672*, Oct. 1941. Riverside county: in a depression on an open gravelly hillside 5 miles east of Indio, *Drouet & Macbride 4700*, in open scrub-forest near Hopkins Well, *Drouet & Macbride 4725, 4728*, in open sandy woods between Arabia and Mecca, *Drouet & Macbride 4772, 4774*, Oct. 1941. Imperial county: on a sandy plain by Salton sea between Pope and Frink stations, *Drouet & Macbride 4763*, on a rocky hillside west of Coyote Well, *Drouet & Macbride 4791*, along irrigation ditches between Brawley and Imperial, *Drouet & Macbride 4818*, Oct. 1941.

*SCHIZOTHRIX PURCELLII* W. R. Taylor Proc. Acad. Nat. Sci. Phila. 80: 91, pl. 12, f. 7–9. 1928. Fila inter alias algas et muscos terrestres crescentia, longa, gracilia, superne fasciculato-ramosa, saepe in fasciculos erectos breves contorta, vaginis hyalinis crassis gelatinosis obscure lamellosis, ambitu erosis, chlorozincico iodurato caerulescentibus; trichomatibus laete aeruginosis, cylindraceis, 3  $\mu$  ad 5  $\mu$  crassis, ad genicula non (aut passim paullo) constrictis, ad apices abrupte attenuatis, intra vaginam inter se distantibus; articulis subquadratis vel diametro usque duplo longioribus, protoplasmate passim granuloso, dissepimentis non granulatis; cellula apicali conica.—On wet barren ground, perhaps often inundated. In *Rhodora* 40: 226, footnote 1 (1938) I interpreted the type material of this species as *S. Friesii* Gom. More recent collections from other parts of its range, however, show that *S. purcellii* as described above is a distinctive species similar to *S. Friesii* but with trichomes mostly unconstricted and with broad gelatinous sheaths. The epithet “purcellii” is properly written here with a small initial letter, since the species is named for the Purcell mountain range. Specimens seen, COLORADO: soil in elymetum on boulderfield, Longs peak, Rocky Mountain national park, *W. Kiener 3253a*, Sept. 1935; on wet rocks east of Berthoud pass, Clear Creek county, *W. L. Tol-*

*stead 10181a*, June 1942. BRITISH COLUMBIA: crust from nearly dried-up pool, parkland, Canon creek near Golden, Kootenay county, *W. R. Taylor*, Sept. 1923 (TYPE in the herbarium of Wm. Randolph Taylor; isotype, D); path above hotel, Glacier, Kootenay county, *Taylor*, 1927 (T, D). CALIFORNIA: Modoc county: on wet ground in the hills 2 miles northwest of Alturas, *Drouet & Richards 4119*, Sept. 1941.

SCHIZOTHRIX CALIFORNICA *Drouet Amer. Midl. Nat.* 29: 52. 1943.—Common in crusts of algae in barren ground in southern California, usually associated with *Microcoleus vaginatus* Gom. Fig. 3. Specimens seen, CALIFORNIA: San Bernardino county: near Cajon pass, Barstow, Hinkley station, Victorville, South pass, Essex, Piute station, Danby, Bagdad, Needles, Vidal, and Lobecks pass, *Drouet & Macbride 4543, 4549, 4552, 4561, 4563, 4564, 4566, 4595, 4604, 4608, 4611a, 4616, 4625, 4629, 4631, 4633, 4635, 4664, 4666, 4675, 4676, 4679, 4694, 4695*, Oct. 1941. Riverside county: on barren ground in open scrub-forest 2 miles southeast of Palm Springs, *Drouet & Macbride 4746* (TYPE), near Vidal, Indio, Shavers Summit, Desert Center, Hopkins Well, Blythe, Palm Springs, and Salton station, *Drouet & Macbride 4652, 4655, 4656, 4697, 4699, 4705, 4709, 4714, 4717-21, 4729, 4750, 4764*, Oct. 1941. Imperial county: Brawley, Coyote Well, and Imperial, *Drouet & Macbride 4777, 4790, 4815*, Oct. 1941.

SCHIZOTHRIX STRICKLANDII *Drouet Amer. Midl. Nat.* 29: 51. 1943.—In crusts of algae on barren ground. Specimens seen, CALIFORNIA: San Bernardino county: south of Needles, *Drouet & Macbride 4678, 4691*, Oct. 1941. Riverside county: 10 miles south of Vidal, *Drouet & Macbride 4654*, Oct. 1941.

SCHIZOTHRIX FRAGILIS (Kütz.) Gom. *Ann. Sci. Nat.* VII Bot. 15: 314. 1892.—On wet rocks. One collection, CALIFORNIA: San Bernardino county: Waterman hot springs, *Setchell 1555*, Dec. 1896.

SCHIZOTHRIX CALCICOLA (Ag.) Gom. *ibid.* 15: 307. 1892. *Hyphoethrix calcicola* Rabenh. ex Gom. *loc. cit.* 1892. *Oscillatoria tortuosa* Gardn.<sup>1</sup> *Mem. N. Y. Bot. Gard.* 7: 34. 1927. *Plectonema tenuissimum* Gardn.<sup>1</sup> *ibid.* 7: 47. 1927.—On wet rocks, woodwork, etc. One specimen, CALIFORNIA: Mono county: on the walls of a small

<sup>1</sup> The filaments indicated by Gardner as *Oscillatoria tortuosa* (PUERTO RICO: Maricao, *Wille 1147a*, Feb. 1915) and as *Plectonema tenuissimum* (PUERTO RICO: Maricao, *Wille 1049b*) in the isotypes in the Herbarium of the University of California are here interpreted as young plants of *Schizothrix calcicola*, although the mass in each case is too scantily developed for better than an arbitrary decision on this point.

tepid spring at the travertine quarry near Bridgeport, *Groesbeck* 343, Apr. 1941.

**SCHIZOTHRIX LARDACEA** (Ces.) Gom. *ibid.* 15: 307. 1892. *Hypheothrix lardacea* Hansg. in Dalla Torre & Sarnth. *Fl. Tirol* 2: 144. 1901.—On wet rocks and soil. The Nevada specimens are placed here tentatively; the sheaths of these become impregnated with silica. Specimens seen, NEVADA: Washoe county: in a hot spring and pool, Steamboat, *Groesbeck* 195b, 284, 367, 1940, 1941. CALIFORNIA: Inyo county: first spring south of Triangle spring, Death valley, *Grinnell* 7628, Oct. 1933. San Bernardino county: Arrowhead hot springs, *Setchell* 1540, Dec. 1896.

**SCHIZOTHRIX CORIACEA** (Kütz.) Gom. *ibid.* 15: 309. 1892. *Hypheothrix coriacea* Kütz. ex Gom. *loc. cit.* 1892.—On wet rocks, woodwork, etc. One specimen, CALIFORNIA: Inyo county: in flume in Furnace creek wash, Death valley, *Groesbeck* 299, Jan. 1941.

**SCHIZOTHRIX LACUSTRIS** A. Br. ex Gom. *ibid.* 15: 301. 1892. *Inactis lacustris* (Gom.) Forti *Syll. Myxophyc.* 354. 1907.—On wet substrata and in shallow fresh water. Specimens seen, CALIFORNIA: Mono county: in a cold pool at the travertine quarry near Bridgeport, *Groesbeck* 40, 158, 237, 242, 250, 348, 1940–41.

**HYDROCOLEUM Groesbeckianum, sp. nov.** Stratum corrugato-crustaceum, ad centimetrum crassum, griseum vel roseum vel aerugineum, calce impregnatum, filis longis gracilibus basi ramosis, passim caespitosis passim intertextis; vaginis cylindraceis gelatinosis hyalinis crassis multi-lamellosis, ambitu erosis, chlorozinceico iodurato haud caerulescentibus, ad apices longe acuminatis; trichomatibus aerugineis vel luteolis, 4  $\mu$  ad 8  $\mu$  crassis, cylindricis, ad genicula non constrictis, ad apices abrupte attenuatis et truncatis, intra vaginas praecipuius solitariis raro duabus vel pluribus; articulis brevibus, praecipue 2–5-plo brevioribus, nonnumquam subquadratis, dissepimentis grosse-granulato, protoplasmate tenuigranuloso; cellula apicali depresso-hemisphaerica vel quasi-truncata, superne membranam incrassatam praebente.—Fig. 4. In this new species, named in honor of M. J. Groesbeck, M. D., the trichomes are somewhat reminiscent of those of *H. heterotrichum* Gom. but are much smaller than in the latter species. The filaments grow as thick slightly calcified crusts submersed in cold pools and streams. Specimens seen, CALIFORNIA: Mono county: in the travertine quarry near Bridgeport, *Groesbeck* 349, Apr. 1941 (TYPE in Cryptogamic Herbarium of Field Museum), *Groesbeck* 271, 272, Nov. 1940.

*MICROCOLEUS CHTHONOPLASTES* (Fl. dan.) Thur. ex Gom. *ibid.* 15: 353. 1892.—In brackish and salt water and on mud. One specimen, CALIFORNIA: Inyo county: bottom of a brine-pool, salt playa on floor of Death valley 35.7 miles south of Furnace creek on the east highway, *Groesbeck 4*, Feb. 1940.

*MICROCOLEUS californicus*, sp. nov. Stratum pannosum expansum rubro-fuscum, filis longis gracilibus intertextis copiose ramosis, basin usque ad 30 trichomata includentibus; vaginis hyalinis crassis gelatinosis inconspicue lamellosis vel fibrosis, ambitu erosis vel levibus vel diffluentibus, chlorozincico iodurato ad apices aegre caerulescentibus; trichomatibus laete aerugineis, 3  $\mu$  ad 4  $\mu$  crassis, ad genicula constrictis; cellulis diametro usque ad 2½-plo longioribus, protoplasmate non aut sparsim grosse-granuloso, dissepimentis conspicuis; cellula apicali acute conica.—In shallow pools of alkaline water. This species has smaller trichomes than has *M. lacustris* Gom.; the sheaths become blue at the tips when treated with chlor-zinc-iodine. Specimens seen, CALIFORNIA: Mono county: in a cold pool in the travertine quarry, Bridgeport, *Groesbeck 168* (TYPE in the Cryptogamic Herbarium of Field Museum), 249, 252, Sept., Nov. 1940. Inyo county: first spring south of Triangle spring, Death valley, *Grinnell 7627* (distributed as *Schizothrix rupicola*), Oct. 1933.

*MICROCOLEUS rupicola* (Tild.), comb. nov. *Schizothrix rupicola* Tild. Amer. Alg. 2: 175. 1896.—Stratum pannosum friabile aerugineum vel decoloratum, filis longis gracilibus, basin robustis cylindricis usque 50 trichomata includentibus, supra copiose ramosis, ramis solitaria vel plura trichomata includentibus; vaginis hyalinis crassis non aut obscure lamellosis, ambitu erosis vel corrugatis, chlorozincico iodurato caerulescentibus; trichomatibus laete aerugineis, 3  $\mu$  ad 4  $\mu$  crassis, ad genicula non aut paullo constrictis, ad apices attenuatis; cellulis diametro praecipuius 1½-plo longioribus, protoplasmate aerugineo, nonnumquam granuloso, dissepimentis non granulatis; cellula apicali longe conica, apice obtusa.—On exposed and barren ground, often found among mosses and young lichens. This is a species widely distributed in North America; many specimens have passed in the literature under the name *Schizothrix arenaria* Gom. *Microcoleus rupicola* belongs near *M. tenerimus* Gom. and *M. acutissimus* Gardn. but differs markedly from the latter two in the configuration of the mature apical cells of the trichomes. Where the filaments have become parasitized by fungi, the sheaths are lamellose and corrugate and simulate those of

*Schizothrix lacustris* Gom. Among the many specimens on file in Field Museum, the following are chosen to illustrate the species and its distribution: MASSACHUSETTS: Gansett estate, Woods Hole, *Drouet* 1217, Aug. 1934. NEW JERSEY: Towaco, Morris county, *Drouet* 2064, June 1937. MARYLAND: Plummers island near Cabin John, Montgomery county, *E. C. Leonard* 2880, Nov. 1941, *Drouet, Killip, & Swallen* 3920, *Drouet & Killip* 3959, July 1941. VIRGINIA: U. S. experimental farm, Arlington, *F. E. Allison* 24, July 1937. INDIANA: bank of Whitewater river, Richmond, *L. J. King* 200, Sept. 1940. MINNESOTA: Soldiers' home, Minnehaha falls, Hennepin county, *C. W. Hall*, Sept. 1896 (isotype in Tild. Amer. Alg. 175). MISSOURI: Ashland, Boone county, *W. B. Drew* 704A, Aug. 1940; 4 miles west of California, Moniteau county, *Drouet* 783, Oct. 1930; bank of Blue river, Swope park, Kansas City, *R. Patrick*, Aug. 1938. NEBRASKA: 1 mile southeast of Wilsonville, *G. H. Giles* 5, Aug. 1937; Republican river near Oxford, *W. Kiener* 11914, Sept. 1941. COLORADO: Evergreen, Jefferson county, *Drouet & A. Cohen* 4925, July 1942. NEW MEXICO: 2 miles west of courthouse, Las Vegas, *Drouet & Richards* 2578, Oct. 1939. ARIZONA-NEVADA: Lake Mead, *E. U. Clover* 82, Apr. 1941. CALIFORNIA: San Bernardino county: south of Needles, *Drouet & Macbride* 4677, 4686, 4689, 4692, Oct. 1941. Merced county: 5 miles east of Los Banos, *Drouet & Macbride* 4393, Oct. 1941. San Diego county: in a garden, Cardiff-by-the-Sea, *Drouet & Macbride* 4862, Oct. 1941. SONORA: along Rio de Sonora, Hermosillo, *Drouet & Richards* 2869, Nov. 1939. GUATEMALA: Laguna de Ocubilá east of Huehuetenango, *P. C. Standley* 82663, Jan. 1941; along Rio Samalá near Santa Maria de Jesús, Dept. Quezaltenango, *Standley* 84746, Jan. 1941; Zacapa, *Standley* 74594, Oct. 1940.

MICROCOLEUS VAGINATUS (Vauch.) Gom. *ibid.* 15: 355. 1892.—Ubiquitous on soil throughout at least the southern part of the region. A considerable number of strains with trichomes of various sizes and colors is concerned; and though vars. *Vaucheri* and *monticola* of Gomont can be distinguished in some collections, there appear to be several strains of these and numerous intermediate kinds. In high rocky and sandy areas, *M. vaginatus* along with species of *Schizothrix* and *Porphyrosiphon* forms a superficial crust wherever silt has collected on ground not occupied by larger plants or covered by decaying leaves. In depressions where water remains standing for some days after rains, the trichomes move out of the

sheaths and form phormidioid masses often confused with *Phormidium autumnale* Gom. and *P. uncinatum* Gom.<sup>1</sup> If the pool becomes permanent, this phormidioid state can be maintained over a long period of time. If the pool dries up, the *Microcoleus vaginatus* continues to grow as a stratum on the soil. Where such a stratum becomes desiccated in a very short time—as is usually the case in the hot deserts—the filaments are found almost invariably to contain single trichomes, and only here and there several. In places where the surface of the ground has been denuded in excavations for buildings and road-construction, this unitrichomatiferous form is also characteristic and almost always present on the cracked surface of the dried mud. Specimens seen, CALIFORNIA: Modoc county: on wet ground in the hills 2 miles northwest of Alturas, *Drouet & Richards* 4128, Sept. 1941. Inyo county: in fresh water, Little lake, *Groesbeck* 75, June 1940 (the phormidioid growth-form). San Bernardino county: near Cajon pass, Newberry, Hinkley station, Hawes station, Adelanto, Essex, Piute station, Danby, Bagdad, Needles, Lobecks pass, and Vidal, *Drouet & Macbride* 4550, 4551, 4555, 4560, 4563, 4565, 4571, 4572, 4575, 4578, 4585, 4593, 4612, 4617, 4618, 4621a, 4623, 4637, 4671, 4674, 4690, Oct. 1941. Riverside county: near Indio, Shavers Summit, Desert Center, Hopkins Well, and Salton Station, *Drouet & Macbride* 4696, 4702, 4704, 4706, 4712, 4717, 4722, 4727, 4765, 4766, 4770, Oct. 1941. Imperial county: by Salton sea between Pope and Frink stations, *Drouet & Macbride* 4761, Oct. 1941.

PLECTONEMA NOSTOCORUM Born. ex Gom. *ibid.* 16: 102. 1892. *Phormidium glaciale* W. & G. S. West<sup>2</sup> *Brit. Antarct. Exped.* 1907–9, *Rept. Sci. Invest., Biol.* 1 (7): 291. 1911. *P. scytonematicola* var. *minus* Gardn.<sup>2</sup> *Mem. N. Y. Bot. Gard.* 7: 42. 1927. *P. epiphyticum* Gardn.<sup>2</sup> *N. Y. Acad. Sci. Sci. Surv. Porto Rico* 8: 281. 1932.—Present in the gelatinous matrices of many algae but not developing in conspicuous masses while the “host” is actively growing. In small bodies of water which have stood for many

<sup>1</sup> It may be of interest here to point out that much of the phormidioid material appearing in water-cultures of soil algae is more probably the phormidioid growth-form of *Microcoleus vaginatus* than of *Phormidium autumnale* or *P. uncinatum*.

<sup>2</sup> Parts of the original material of *Phormidium glaciale* from Antarctica (Clear lake, Coast lake, and Blue lake, Ross island, *Shackleton Expedition*, 1908) in the Herbarium of the University of California are almost pure masses of *Plectonema Nostocorum*. Isotypes of *Phormidium scytonematicola* var. *minus* (PUERTO RICO: 10 km. north of Utuado, *Wille* 1565a) and *P. epiphyticum* (PUERTO RICO: Santurce, *Howe* 2162b, May 1903) in the Herbarium of the University of California contain typical filaments of *Plectonema Nostocorum*.

months—in culture-dishes, jars of water, urns in cemeteries, watering-troughs for animals, and small more or less permanent pools in which other algae have not continued to grow because of unfavorable conditions—this species is often the principal constituent of the climax association of algae. The same is true of associations of algae on exposed soil which remains wet for long periods of time. Specimens seen, NEVADA: Washoe county: in a cold stream, Steamboat, *Groesbeck* 446, July 1941. CALIFORNIA: Modoc county: on wet ground beside the north fork of Pit river, Alturas, *Drouet & Richards* 4174, Sept. 1941. Mono county: on a submerged tufa-crag, northwest portion of Mono lake, *Groesbeck* 81, June 1940. Inyo county: culture from Bad Water, Death valley, *Holman & Bonar* 7800, Apr. 1933; stream about  $\frac{1}{2}$  mile east of Furnace creek inn, Death valley, *Groesbeck* 14, Feb. 1940.

PLECTONEMA WOLLEI Farl. ex Gom. *ibid.* 16: 98. 1892. *Lyngbya magnifica* Gardn.<sup>1</sup> Mem. N. Y. Bot. Gard. 7: 40. 1927.—In streams and lakes. One collection, CALIFORNIA: Inyo county: in Furnace creek, Death valley, *Parish* 10465, May 1905 (C).

SYMPLOCA KIENERI Drouet Amer. Midl. Nat. 29: 53. 1943.—In barren depressions in sand. One specimen, CALIFORNIA: San Bernardino county: Santa Ana wash north of Redlands, *Hollenberg* 3165, Mar. 1941.

SYMPLOCA MURALIS Kütz. ex Gom. *ibid.* 16: 112. 1892. *S. muralis* var. *minor* Gardn. Univ. Calif. Publ. Bot. 14: 6. 1927. *S. symbiotica* Gardn.<sup>2</sup> Mem. N. Y. Bot. Gard. 7: 48. 1927. *Phormidium rubriterricola* Gardn.<sup>2</sup> *ibid.* 7: 43. 1927.—On soil often wet with fresh water. One specimen, CALIFORNIA: Riverside county: on soil in a pot in United States Department of Agriculture greenhouse, Riverside, *Hollenberg* 2516, Feb. 1939.

SYMPLOCA THERMALIS (Kütz.) Gom. *ibid.* 16: 114. 1892.—On wet rocks and woodwork in and about hot springs. One specimen, CALIFORNIA: Inyo county: outlet of swimming pool, Keough hot springs, *Groesbeck* 390, July 1941.

LYNGBYA AESTUARII (Mert.) Liebm. ex Gom. Ann. Sci. Nat. VII Bot. 16: 127. 1892. *L. ocreata* Gardn. Mem. N. Y. Bot. Gard. 7:

<sup>1</sup>The isotype of *Lyngbya magnifica* in the Herbarium of the University of California (PUERTO RICO: in a water reservoir, Rio Piedras, *Wille* 105, Dec. 1914) is excellent material of *Plectonema Wollei*.

<sup>2</sup>Isotypes of *Symploca symbiotica* (PUERTO RICO: Fort San Cristobal, San Juan, *Wille* 2021b) and *Phormidium rubriterricola* (PUERTO RICO: on red earth, Maricao, *Wille* 1057, Feb. 1915) in the Herbarium of the University of California are characteristic masses of *Symploca muralis*.

39. 1927. *L. scytonematoides* Gardn. loc. cit. 1927.—In fresh and brackish water and on soil. Specimens seen, CALIFORNIA: Modoc county: on mud beside the north fork of Pit river, Alturas, *Drouet & Richards* 4174, 4175, Sept. 1941. Inyo county: floating in Little lake, *Groesbeck* 152, 153, 386, Sept. 1940, July 1941; in a cold stream 1 foot from the outlet of Keough hot springs, *Groesbeck* 230, Nov. 1940. San Bernardino county: floating in a shallow reservoir, Old Woman springs, *Hollenberg* 2082b, May 1937. Imperial county: in a ditch in an open field at the south edge of Brawley, *Drouet & Macbride* 4776, Oct. 1941; in very shallow water in a salt marsh beside Carrizo creek west of Calexico, *Drouet & Macbride* 4803, 4804, Oct. 1941.

LYNGBYA VERSICOLOR (Wartm.) Gom. *ibid.* 16: 147. 1892. *Leptothrix tenax* Wolle F. W. Alg. U. S. 319. 1887. *Hypheothrix tenax* Wolle ex Forti Syll. Myxophyc. 329. 1907. *L. erecta* Gardn.<sup>1</sup> Mem. N. Y. Bot. Gard. 7: 38. 1927 (not Setch. & Gardn.). *Phormidium mucosum* Gardn.<sup>1</sup> *ibid.* 7: 43. 1927.—One specimen, from fresh water, CALIFORNIA: Mono county: on grass-stems in a cold pool at the travertine quarry near Bridgeport, *Groesbeck* 273a, Nov. 1940.

LYNGBYA OCHRACEA (Kütz.) Thur. ex Gom. *ibid.* 16: 149. 1892. *Leptothrix ochracea* Kütz. Phyc. gen. 198. 1843.—In pools of seepage-water. Specimens seen, CALIFORNIA: Modoc county: in a springy place beside the north fork of Pit river, Alturas, *Drouet & Richards* 4183, Sept. 1941. Riverside county: beside the stream in the lower part of Palm canyon near Palm Springs, *Drouet & Macbride* 4732, Oct. 1941.

PHORMIDIUM GROESBECKIANUM Drouet Field Mus. Bot. Ser. 20: 137, f. 7. 1942.—Among other algae in hot springs. One specimen, the type, NEVADA: Washoe county: Steamboat, *Groesbeck* 195a, Sept. 1940.

PHORMIDIUM LAMINOSUM Gom. *ibid.* 16: 167. 1892.—Forming the conspicuous algal masses, mainly as gelatinous strata, in many of the hot springs of the region. It is found here in water of all temperatures up to about 160° F. Many strains differing in diameter of trichome are encountered in the various groups of springs, and often in the same spring. In very hot water, and in some places in cooler water, the trichomes break up into hormogonia each of one or two protoplasts which individually simulate those of certain anacy-

<sup>1</sup> The isotypes of *Lyngbya erecta* Gardn. (PUERTO RICO: on stones in a brook in the vicinity of San Lorenzo, *Wille* 501a, Jan. 1915) and *Phormidium mucosum* (PUERTO RICO: in a basin in a garden in Humacao, *Wille* 641, Jan. 1915) are typical masses of *Lyngbya versicolor*.



stoid Chroococcaceae. As in species of *Anacystis*, the diameter of these protoplasts (hormogonia here) may become greater or less; and if such hormogonia subsequently grow in length, the resulting long trichomes retain the diameters assumed by the hormogonia. Specimens seen, including that reported by Inman in Journ. Gen. Physiol. 23: 665 (1940), NEVADA: Eureka county: in a hot spring, Beowawe, O. L. Inman, July 1939. Washoe county: in hot pools and springs, Steamboat, *Groesbeck* 24, 113, 115, 279-281, 287, 288, 290, 358, 363, 364, 366, 426, 431, 432, 434, 438, 444, 1940-41. CALIFORNIA: Modoc county: in Hot Springs, southwestern part of county, *Hall & Babcock*, June 1903. Sierra county: in Campbells hot springs, *Hall & Babcock*, June 1903. Mono county: in hot springs and pools at the travertine quarry near Bridgeport, *Groesbeck* 30, 33, 34, 48, 91, 93, 98, 102, 157, 159, 164, 165, 173, 177, 180, 235, 236, 238, 239, 241, 243, 263, 267, 270, 323, 325, 327, 334, 340, 346, 347, 457, 459, 482, 1940-41; Fales hot springs, *Groesbeck* 26a, 104, 181, 187, 275, 276, 353, 354, 452-454, 1940-41; in Hot creek and geysers, *Groesbeck* 201, 204, 209, 210, 212, 402, 404, 405, 407, 408a, 416, 419, 421, 1940-41; in and about a very hot artesian well on the north shore of Mono lake, *Groesbeck* 130, 131, Sept. 1940. San Bernardino county: Waterman hot springs, *Setchell* 1580, 1581, 1583, Dec. 1896; Arrowhead hot springs, *Parks* 3243, Dec. 1929, *Gardner* 6, 14, 16, 19, 41, May 1930.

PHORMIDIUM TRELEASEI Gom. Bull. Soc. Bot. Fr. 46: 37. 1899.—In waters of various temperatures (chiefly 100-160° F.) in hot springs in the region. It may be confused easily with the more tenuous strains of *P. laminosum* and *P. tenue*. Specimens seen, including those reported by Inman in Journ. Gen. Physiol. 23: 665 (1940), NEVADA: Eureka county: in a hot spring, Beowawe, O. L. Inman, July 1939. Washoe county: in hot springs, Steamboat, *Groesbeck* 23, 112, 193, 197, 282, 374, 427, 439, 442, 1940-41. CALIFORNIA: Modoc county: Hot Springs, southwestern part of county, *Hall & Babcock*, June 1903. Mono county: in hot springs and streams at the travertine quarry near Bridgeport, *Groesbeck* 31, 35, 36, 160, 246, 255, Apr.-Nov. 1940; in a small hot spring at Hot creek about 2 miles south of Whitmore Tub springs, *Groesbeck* 60, June 1940; in a small pool in rocks, Hot creek and geysers, *Groesbeck* 203, Nov. 1940. Inyo county: in the largest hot spring, Keough hot springs, *Groesbeck* 396, July 1941.

PHORMIDIUM TENUE (Menegh.) Gom. Ann. Sci. Nat. VII Bot. 16: 169. 1892.—In fresh water; commonly found in many hot springs

in the region in water with temperatures up to 140° F. Masses of unicellular and bicellular hormogonia of this species, similar to those described under *P. laminosum* above, are present in certain springs. Specimens seen, NEVADA: Washoe county: in the hot springs, Steamboat, *Groesbeck* 111, 277, 357, 369, 430, 445, 449, 1940-41. CALIFORNIA: Mono county: in hot springs and streams in the travertine quarry near Bridgeport, *Groesbeck* 45, 89, 97, 156, 163, 170, 176, 178, 244, 245, 253, 262, 324, 328, 337, 345, 460, 466, 468, 478, 479, 1940-41; at the vent, Casa Diablo geyser, *Groesbeck* 322, Apr. 1941; scrapings from steps at a large cold spring, Fales hot springs, *Groesbeck* 184, Sept. 1940. Inyo county: in pools, streams, and springs, Keough hot springs, *Groesbeck* 66-68, 71, 143-146, 148-148b, 226-228, 232, 233, 309-312, 314-317, 389, 391-393, 395, 397, 398, 1940-41; on the standpipe at Furnace creek ranch, Death valley, *Grinnell* 7624, Oct. 1933; in Benton hot springs, *Mrs. Partz*, Aug. 1866, *Duran* 7794, Apr. 1935; hot pool and spring, the Geysers, *Groesbeck* 134, 142, Sept. 1940. San Bernardino county: hot springs, San Bernardino mountains, *Parish*, June 1891 (D, F); Arrowhead hot springs, *Gardner* 8, 23, 44, 45, May 1930.

*PHORMIDIUM VALDERIANUM* Gom. *ibid.* 16: 167. 1892.—In fresh water. Specimens seen, CALIFORNIA: Imperial county: pool at the carbon-dioxide wells, south end of Salton sea, *Groesbeck* 53, 54, Jan. 1940.

*PHORMIDIUM RETZII* (Ag.) Gom. *ibid.* 16: 175. 1892. *P. leptodermum* var. *capitatum* Gardn. Mem. N. Y. Bot. Gard. 7: 43. 1927.—In fresh water. Specimens seen, CALIFORNIA: Modoc county: in shallow water in the sloughs along the north fork of Pit river, Alturas, *Drouet & Richards* 4161, Sept. 1941. San Bernardino county: in seepage on the wall of an artificial reservoir north of Redlands, *Hollemberg* 3060, Dec. 1939.

*PHORMIDIUM SUBFUSCUM* Gom. *ibid.* 16: 184. 1892.—In flowing fresh water. One specimen, CALIFORNIA: San Bernardino county: on rock in trickle from spillway emptying into an artificial reservoir north of Redlands, *Hollemberg* 3059, Dec. 1939.

*PHORMIDIUM UNCINATUM* (Ag.) Gom. *ibid.* 16: 184. 1892.—In fresh water. Specimens seen, CALIFORNIA: Modoc county: in sloughs, swales, and drains beside the north fork of Pit river, Alturas, *Drouet & Richards* 4133, 4139, 4141, 4149, Sept. 1941. Inyo county: on plant stems, pool in stream flowing from Monument headquarters to the playa in the bottom of Death valley, *Groesbeck* 9, Feb. 1940. San Bernardino county: scum in a water-vessel near Redlands,

*Hollenberg 3162*, Feb. 1941. Riverside county: on rocks in swift water below the falls in Tahquitz canyon near Palm Springs, *Drouet & Macbride 4744*, Oct. 1941.

OSCILLATORIA PRINCEPS Vauch. ex Gom. *ibid.* 16: 206. 1892. *O. princeps* f. *purpurea* Coll. in Coll. Hold. & Setch. Phyc. Bor-amer. 16: 753. 1900. *O. obtusa* Gardn. Mem. N. Y. Bot. Gard. 7: 38. 1927. *Lyngbya gigantea* Lew. Zirk. & Patr. Journ. Mitch. Sci. Soc. 1933: 221. 1933.—In fresh water, and in hot water with temperatures up to (in these collections) 120° F. Specimens seen, CALIFORNIA: Mono county: in creek, pools, and hot springs, Hot creek and geysers, *Groesbeck 205, 207, 208, 413, 414*, Nov. 1940, July 1941. San Bernardino county: Arrowhead hot springs, *Gardner 11*, May 1930.

OSCILLATORIA SANCTA Kütz. ex Gom. *ibid.* 16: 209. 1892.—Submersed and subaerial in fresh water. Specimens seen, CALIFORNIA: San Bernardino county: Arrowhead hot springs, *Gardner 4, 10*, May 1930.

OSCILLATORIA TENUIS Ag. ex Gom. *ibid.* 16: 220. 1892. *O. americana* Kütz. ex Gom. (as sp. inquir.) *ibid.* 16: 236. 1892; Kütz.<sup>1</sup> Tab. Phyc. 1: 28. 1847.—In fresh water. Specimens seen, CALIFORNIA: Modoc county: in pools and sloughs along the north fork of Pit river, Alturas, *Drouet & Richards 4138, 4142, 4151, 4156*, Sept. 1941. Mono county: in the outlet of a spring on the east shore of Mono lake, *Groesbeck 127*, Sept. 1940. Inyo county: floating in Little lake, *Groesbeck 384*, July 1941; near Borax lake, Death valley, *Wilkinson*, June 1910; with *Phormidium uncinatum* on plant stems, pool in stream flowing from Monument headquarters to a playa in the bottom of Death valley, *Groesbeck 9*, Feb. 1940. San Bernardino county: in a temporary pool, Redlands, *Hollenberg 3097*, Apr. 1940. Riverside county: in shallow water of Colorado river 10 miles south of Vidal, *Drouet & Macbride 4645, 4647*, Oct. 1941. Imperial county: in a freshwater stream by Salton sea between Pope and Frink stations, *Drouet & Macbride 4759*, Oct. 1941.

OSCILLATORIA CHLORINA Kütz. ex Gom. *ibid.* 16: 223. 1892.—In fresh water. This species is represented sparingly in one collection, CALIFORNIA: San Bernardino county: with *O. amphibia* floating in upper "multiple lakes" in San Timoteo canyon near Redlands, *Hollenberg 3080*, Feb. 1940.

<sup>1</sup> Material labeled "Oscillaria americana Kutz. Antillen. ex herb. Kützing" and presumably collected by R. Schomburgk, in the Herbarium of the University of California is easily recognizable as *O. tenuis*.

OSCILLATORIA AMPHIBIA Ag. ex Gom. *ibid.* 16: 221. 1892.—In brackish and fresh water. One collection, CALIFORNIA: San Bernardino county: floating in upper "multiple lakes" in San Timoteo canyon near Redlands, *Hollenberg 3080*, Feb. 1940.

OSCILLATORIA SPLENDIDA Grev. ex Gom. *ibid.* 16: 224. 1892. *O. splendida* f. *uncinata* Setch. & Gardn.<sup>1</sup> Univ. Calif. Publ. Bot. 1: 184. 1903.—In fresh water. One specimen, CALIFORNIA: Modoc county: with *Cylindrospermum licheniforme* on the shore of the north fork of Pit river, Alturas, *Drouet & Richards 4179*, Sept. 1941.

OSCILLATORIA AMOENA (Kütz.) Gom. *ibid.* 16: 225. 1892.—In fresh water. Specimens seen, NEVADA: in a small basin, Steamboat hot springs, *Groesbeck 114a*, June 1940. CALIFORNIA: Mono county: in a cold pool in the travertine quarry near Bridgeport, *Groesbeck 39*, Apr. 1940.

OSCILLATORIA FORMOSA Bory ex Gom. *ibid.* 16: 230. 1892.—In fresh water. One specimen, CALIFORNIA: floating in the travertine quarry near Bridgeport, *Groesbeck 266*, Nov. 1940.

OSCILLATORIA CHALYBEA Mert. ex Gom. *ibid.* 16: 232. 1892. *O. trapezoidea* Tild. Bull. Torr. Club 23: 58. 1896.—In fresh and brackish water. Specimens seen, including that reported by Hutchinson in Trans. Conn. Acad. Sci. 33: 83 (1937), NEVADA: Churchill county: with *Spirulina subsalsa*, margin of Big Soda lake near Fallon, *Hutchinson*, July 1933 (D). CALIFORNIA: Mono county: in a warm spring, east shore of Mono lake, *Groesbeck 126*, Sept. 1940; in warm springs in the travertine quarry near Bridgeport, *Groesbeck 99, 474*, 1940–41. Inyo county: in a tepid spring in Furnace creek wash, Death valley, *Groesbeck 296*, Jan. 1941. San Bernardino county: in a hot creek in a canyon, Arrowhead springs, *Parks 3245b*, Dec. 1929; with *O. amphibia* floating in upper "multiple lakes" in San Timoteo canyon near Redlands, *Hollenberg 3080*, Feb. 1940.

OSCILLATORIA BREVIS Kütz. ex Gom. *ibid.* 16: 229. 1892.—Chiefly on mud, less often seen in shallow water. Specimens seen, CALIFORNIA: Modoc county: in the drain from the ice-factory, Alturas, *Drouet & Richards 4141*, Sept. 1941. Mono county: in a small cold pool, Hot creek geysers, *Groesbeck 412*, July 1941. Riverside county: with *Symploca muralis* on soil in a pot in the United States Depart-

<sup>1</sup>*O. splendida* f. *uncinata* as represented by the TYPE (WASHINGTON: Whidbey island, *Setchell & Gardner 574*, July 1901) in the Herbarium of the University of California appears to me not to deserve formal distinction among the many strains and growth-forms of *O. splendida*.

ment of Agriculture greenhouse, Riverside, *Hollenberg* 2516, Feb. 1939.

OSCILLATORIA BORYANA Bory ex Gom. *ibid.* 16: 234. 1892.—In hot springs. Specimens seen, NEVADA: Washoe county: in hot springs, Steamboat, *Groesbeck* 195, 198, Sept. 1940. CALIFORNIA: Mono county: in a pool, Hot creek geysers, *Groesbeck* 403, 408, July 1941.

OSCILLATORIA TEREBRIFORMIS Ag. ex Gom. *ibid.* 16: 234. 1892.—In hot springs. Specimens seen, CALIFORNIA: Mono county: in a pool and on wet earth, Hot creek and geysers, *Groesbeck* 200, 401, 1940–41; in a water-trough in the travertine quarry near Bridgeport, *Groesbeck* 247, 329, 1940–41. San Bernardino county: Harlem hot springs, *Setchell* 1559, Dec. 1896; Arrowhead hot springs, *Gardner* 1, 2, 7, 9, May 1930.

SPIRULINA MAJOR Kütz. ex Gom. *ibid.* 16: 251. 1892. *S. densa* Lill. Amer. Mid. Nat. 16: 210. 1935.—In shallow fresh and brackish water. Found sparingly in one specimen, CALIFORNIA: San Bernardino county: with *Oscillatoria amphibia* floating in upper "multiple lakes" in San Timoteo canyon near Redlands, *Hollenberg* 3080, Feb. 1940.

SPIRULINA SUBSALSA Oerst. ex Gom. *ibid.* 16: 253. 1892. *Arthrospira subsalsa* Crow apud Croasd. F. W. Alg. Woods Hole, Mass. 18. 1935.—In brackish and salt water. One specimen, reported by Hutchinson in Trans. Conn. Acad. Sci. 33: 83 (1937), NEVADA: Churchill county: margin of Big Soda lake near Fallon, *G. E. Hutchinson*, July 1933 (D).

SPIRULINA LABYRINTHIFORMIS (Menegh.) Gom. *ibid.* 16: 255. 1892.—In warm water in and about hot springs. Specimens seen, NEVADA: Washoe county: in a small basin in a calcareous deposit, Steamboat springs, *Groesbeck* 114a, June 1940. CALIFORNIA: Mono county: in a cold pool, Hot creek geysers, *Groesbeck* 417, July 1941; in warm and cold pools in the travertine quarry near Bridgeport, *Groesbeck* 44, 161, 166, 167, 273, 332, 461, 1940–41.





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